MAROTTA/MAIN
ARCHITECTS

PROJECT MANUAL

VOLUME 1 OF 3 – LEGAL SPECIFICATIONS

CHANCELLOR CENTER RENOVATIONS
30 N Chancellor Street
Newtown, PA 18940

for

COUNCIL ROCK SCHOOL DISTRICT
30 N Chancellor Street
Newtown, PA 18940

BID SET
OCTOBER 13, 2026

COUNCIL ROCK SCHOOL DISTRICT
CHANCELLOR CENTER RENOVATIONS

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PART 1 - List of Drawing Sheets

1.1 LIST OF DRAWINGS

A. Drawings: Drawings consist of the Contract Drawings and other drawings listed on the Table of Contents page of the separately bound drawing set titled Chancellor Center Renovations dated 13 October, 2026, as modified by subsequent Addenda and Contract modifications.

B. List of Drawings: Drawings consist of the following Contract Drawings and other drawings of type indicated:

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A0.3 LIFE SAFETY PLANS
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SECTION 00 11 00 – INSTRUCTIONS TO BIDDERS

1. GENERAL

1.1 The drawings and specifications are complimentary via the Building Connected Program. Any labor and/or material not shown on the drawings but called for in the specifications or any labor and/or material not called for in the specifications but shown on the drawings, shall be furnished by the contractor as though shown and called for in both.

1.2 DEFINED TERMS

1.2.1 Terms used in these Instructions to Bidders, which are defined in the General Conditions of the Contract for Construction (the “General Conditions”), have the meanings assigned to them in the General Conditions. The term "Bidder" means one who submits a Bid directly to Owner, as distinct from a sub-Bidder, who submits a bid to a Bidder. The term "Successful Bidder" means the lowest, qualified, responsible, and responsive Bidder to whom Owner (on the basis of Owner's evaluation as hereinafter provided) makes an award. The term "Bidding Documents" includes the Advertisement or Invitation to Bid, Instructions to Bidders, the Bid Form, and the Contract Documents (including all Addenda issued prior to receipt of Bids). The numbering system refers to Articles.

2. COPIES OF BIDDING DOCUMENTS

2.1 In order to Bid the Project, complete sets of PDF documents must be obtained.

2.2 Complete sets of Bidding Documents must be used in preparing Bids; neither Owner, Architect, or Construction Manager assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents. Bidding Documents consist of Contract Documents (and all reference standards), specifications, addenda, and drawings. Bidder is responsible to make sure that the set of Bidding Documents is complete and that any printed contract document is legible and represents properly all the information as represented in the PDF file.

2.3 Owner, Architect, and Construction Manager, in making copies of the Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not confer a license or grant for any other use.

3. QUALIFICATIONS OF BIDDERS

3.1 **The following information must be completed and submitted when requested by the Construction Manager.**

3.1.1 The Contractors Qualification Statement A305-2020 found in Section 00 1940. Use additional pages to complete any of the sections if more space is needed. Bidder’s failure to fully and accurately disclose all information requested in the Request for Qualifications questionnaire shall constitute grounds for Bidder’s disqualification from being considered the lowest responsive, responsible Bidder.

3.2 To demonstrate qualifications to perform the Work, each Bidder must be prepared to submit with their bid proposal, written evidence such as financial data, insurance certificates, previous experience of the Bidder and its assigned personnel, present commitments, and any other information that may be requested by the Owner. Each Bid must contain evidence of Bidder's qualification to do business in the Commonwealth of Pennsylvania, or covenant to obtain such qualification prior to award of the Contract. Owner reserves the right to reject Bidder if he cannot satisfy all of the Qualification Requirements, including those listed in the Technical Specifications.

3.3 In determining the lowest responsible Bidder, the Owner will consider the integrity, efficiency, experience of the Bidder and its assigned personnel, promptness, current workload, financial capability, performance on recent projects, references from owners, architects, and engineers, list of potential sub-contractors, schedule of values, and ability to successfully and timely complete the Project**.** The apparent low Bidder must demonstrate competency and provide any or all of the above information requested within three (3) calendar days of request. Owner reserves the right to reject the Bidder as non-responsive if all the information is not received on time and/or does not reasonably satisfy the Owner's evaluation process.

3.4 In addition to all the requirements specified in Articles 3.1, 3.2 and 3.3 regarding qualifications of Bidders, the Owner will evaluate Bidders using the following additional criteria:

3.4.1 The Bidder and its assigned personnel must have successfully performed a minimum of 3 previous Pennsylvania public school projects within the last 5 years of similar type or a contract value of at least seventy-five percent (75%) of the amount of the Bidder's Base Bid. Provide references including telephone number and contact person.

3.4.2 The Bidder shall perform not less than ten percent (10%) of the actual construction Work with staff employed directly by the Bidder. Project Management and Office Staff shall NOT be included in this percentage.

3.4.3 The Bidder, or its assigned personnel, must have successfully performed at least 3 Pennsylvania public school projects within the last 5 years where they have managed multiple trades and coordinated and scheduled all the activities for projects as per Article 3.4.1. Provide references including telephone number and contact person.

3.4.4 An Agreement of Surety certifying that the Surety Company is committed to provide the Bidder with a Performance Bond and Payment Bond each in the amount of one hundred percent (100%) of the contract amount. The Surety Company must have an AM Best rating of A- or higher and a financial rating of Class X or higher.

3.4.5 The Bidder's performance on previous projects including claims, litigation, coordination of work, staffing, and timely completion. If it is determined that the Bidder has not fully performed previous projects in a coordinated, timely, and good and workmanlike manner, the Owner reserves the right to reject the Bid.

3.4.6 The Bidder shall also refer to Articles 11.

3.5 Owner shall be entitled to recover attorneys' fees and costs incurred in defending any unsuccessful challenge brought by a Bidder in its own name or as proxy for a School District resident to Owner's award of a contract to another Bidder, from the Bidder who brought the unsuccessful challenge as more fully set forth in Section 13.8.1 of the General Conditions of Contract.

3.6 All Bidders should be aware that the Owner encourages and promotes MBE (Minority Business Enterprise) and WBE (Women's Business Enterprise) participation for this Project. Bidders are encouraged to do their own research on the qualifications, and other factors, in preparing a comprehensive and responsible bid.

4. EXAMINATION OF CONTRACT DOCUMENTS AND SITE

4.1 It is the responsibility of each Bidder, before submitting a Bid, to:

1. Examine the Contract Documents thoroughly.
2. Visit the site to become familiar with local conditions that may affect the cost, progress, performance, or furnishing the Work.
3. Consider federal, state, and local laws and regulations that may affect cost, progress, performance, or furnishing of the Work.
4. Study and carefully correlate Bidder's observations with the Contract Documents.

5. Notify Architect and Construction Manager of any conflicts, errors, or discrepancies discovered in the Contract Documents.

4.1.1 REVIEW OF DRAWINGS AND SPECIFICATIONS

A. Bidders shall thoroughly examine and be familiar with the Specifications and Drawings. The failure or omission of any Bidder to receive or examine any form, instrument, document, or visit the site and acquaint himself with conditions there existing, shall in no way relieve any Bidder from obligation with respect to his or her Bid. By submitting a Bid, the Bidder agrees and warrants that he/she has examined the site and the Specifications and Drawings and, where Specifications and/or Drawings require in any part of the Work a given result to be produced, that the Specifications and Drawings are adequate, and the required result can be produced under the Specifications and Drawings. No claim for any additional costs will be allowed because of alleged impossibilities in the production of the results specified or because of inadequate or improper plans and specifications and whenever a result is required, the successful Bidder shall furnish any and all extras and make any changes needed to produce the required result for the sum stated in the form of proposal.

B. Should any Bidder find discrepancies, duplications, or omissions in the documents or have doubt as to the meaning expressed by the Contract Documents, he/she shall make inquiry at once in writing to the Architect and Construction Manager. Where changes, corrections, or clarifications to Contract Documents are deemed necessary by the Architect and/or Construction Manager, he will issue written Addenda accordingly. Addenda shall be a part of the Contract Documents. No oral, telephone, email, or letter instructions will be considered as having effect upon the Contract Documents; Addenda only shall constitute change to them. Bidders and sub-Bidders are urged to make early examination of Contract Documents and make inquiries about them, if necessary, even though prices may not be determined until late in the bidding period.

4.2 The site may be made available for visits at the pre-bid conference and at the other specific designated dates and times determined at the pre-bid conference.

4.3 Information and data reflected in the Contract Documents with respect to underground facilities at or contiguous to the site is based upon information and data furnished to Owner and Architect and/or Construction Manager by owners of such underground facilities or others, and Owner and Architect and/or Construction Manager do not assume responsibility for the accuracy or completeness thereof. Successful Bidder shall verify the location of all underground utilities prior to any excavation.

4.4 Successful Bidder for the General Contract is responsible, on behalf of the Owner, for providing the physical markings of all existing utilities including those on site as indicated on the drawings or that may be identified in the field. The locations shown on the drawings are approximate. The Bidder must include in his proposal the cost for hand-dug test holes, or other means, to ascertain the precise position of such underground facilities on the site owned by the Owner. This verification should be performed for any utilities to be relocated, removed, modified, or that may otherwise interfere with planned work. The utilities in the public right of way will be identified and marked by the appropriate facility owner as per the requirements of the PA One Call Act as amended. Physical layout is to be performed in full compliance with the PA One Call PA Act 287 of 1974 as amended by Act 18 of 1996 and Act 50 of 2017.

4.5 The Owner, Architect, and Construction Manager will not be responsible for the adequacy of data furnished to prospective Bidders on subsurface conditions, underground facilities, and other physical conditions. This information is provided based on information available. Bidder assumes responsibility for verifications, adjustments, and modifications that may be required since this is generally recognized as inherent to the work of the Contract Documents.

4.6 Before submitting a Bid, each Bidder will, at Bidder's expense, make or obtain any additional examinations, investigations, explorations, tests and studies, and obtain any additional information and data which pertain to the physical conditions (surface, subsurface, and underground facilities) at or contiguous to the site or otherwise which may affect cost, progress, performance, or furnishing the Work

and which Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price, and other terms and conditions of the Contract Documents.

4.7 On request in advance, Owner will provide each Bidder access to the site to conduct such explorations and tests, as each Bidder deems necessary for submission of a Bid. Bidder shall fill all holes, clean up, and restore the site to its former condition upon completion of such explorations.

4.8 The lands upon which the Work is to be performed, rights-of-way, and easements for access thereto and other lands designated for use by the Bidder in performing the Work are identified in the Contract Documents. All additional lands and access thereto required for temporary construction facilities or storage of materials and equipment are to be provided by Bidder. Easements for permanent structures or permanent changes in existing structures are to be obtained and paid for by Owner unless otherwise provided in the Contract Documents.

4.9 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of the Bidding Documents and, that without exception, the Bid is premised upon performing and furnishing the Work required by the Contract Documents and such means, methods, techniques, sequences, or procedures of construction as may be indicated in or required by the Contract Documents, and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

5. SCOPE

5.1 Contracts will be awarded in five (5) prime contracts: Separate bids shall be submitted for: (BP-01) General Construction, (BP-02) Plumbing/Fire Protection Construction, (BP-03) Mechanical Construction, (BP-04) Electrical Construction, and Abatement Construction (BP-05).

5.2 Each prime contractor shall furnish all labor, equipment, and materials necessary to complete the work called for and implied by the plans and specifications.

6. TIME

6.1 The Contract Documents include potential assessment of Liquidated Damages. Refer to AIA Document A132 – 2019, Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition.

7. INTERPRETATIONS OF CONTRACT DOCUMENTS PRIOR TO BIDDING

7.1 If any person submitting a bid for construction of the Work is in doubt as to the true meaning or intent of any part of the proposed Contract Documents, or find discrepancies or omissions, they shall submit a request for information via Building Connected to the Architect and Construction Manager no later than the date indicated in the Bid Schedule.

7.2 Interpretation or correction of proposed Contract Documents will be made only by Addendum and will be released to all prime contract bidders of record, via Building Connected. The Owner, Architect, and Construction Manager will not be responsible for any other explanations or interpretations of the proposed Contract Documents.

7.3 During the bidding period, Bidders may be furnished these Bid Addenda modifying the Bid Documents. Any such Addenda shall be taken into account in submitting a Bid and shall form a part of the Contract Documents. Receipt of Bid Addenda must be identified on Bid Form via Building Connected.

7.4 When mistakes or omissions occur in the drawings and/or specifications, they shall be brought to the Construction Manager's attention before proceeding with the work.

7.5 All construction shall be in accordance with all federal, state, and local building codes and ordinances, which shall take precedence over these drawings and specifications.

7.6 Manufacturer's directions – All manufacturer's articles, materials and equipment shall be supplied,

installed, connected, cleaned or conditioned in strict accordance with the manufacturer's printed directions.

7.7 If there is a discrepancy between the contract documents and the information on Building Connected, the contract document requirements shall prevail in all cases.

8. REQUESTS FOR INFORMATION

8.1 If additional information is required concerning the meaning or intent of the Bid Documents, all questions and requests for information must be submitted electronically via Building Connected.

9. SUBMISSION OF PROPOSALS

9.1 Bids shall be submitted at the time and place indicated in the Advertisement for Bids and shall be enclosed in an opaque, sealed envelope, marked with the Project title, Contract No., and, if applicable, the designated portion of the Project for which the Bid is submitted. Envelopes shall contain the name and address of the Bidder and accompanied by the documents listed below. If the Bid is sent through the mail or other delivery system, the sealed envelope shall be enclosed in another envelope with the notation "BID ENCLOSED" on the face if it. One (1) hard copy of all documents listed below are required to be submitted at the time of the Bid. Receipt of Bid is acknowledged when delivered to the Owner and not when mailed.

9.2 Each Bidder shall submit one (1) hard copy of the complete bid submission.

The following shall be included in the bid submission:

1. Form of Proposal, fully executed and notarized
2. Bid Bond or Certified Check or Cashier's check in the amount of 10% of the Bid total and shall include Consent of Surety and Power of Attorney
3. Non-Collusion Affidavit, Signed and Sealed
4. Non-Discrimination Clause, Signed and Sealed
5. PA Public Works Employment Verification Form (E-Verify)

Note that the following will be required to be submitted by ALL Bidders at the request of the Construction Manager within 48 hours of bid submission:

1. Bidder's Qualifications, AIA A305, completed
2. Schedule of Values
3. List of Subcontractors
4. Safety Questionnaire

Note that the successful bidder will be required to submit the following documents and any other documents deemed necessary by the Construction Manager upon issuance of Letter of Intent to Award:

1. Certificate of Insurance
2. Performance Bond in the amount of 100%
3. Payment Bond in the amount of 100%
4. No Lien Agreement
5. Maintenance Bond

10. BIDDERS RESPONSIBILITIES

10.1 Bidders will be given permission to withdraw any proposal after it has been received by the Owner, provided the Bidder or his agent duly authorized to act for him, personally appears at the Owner's Business Office with a written request signed by the Bidder prior to the time set forth for the opening of the Bids. At the time set for the opening of Bids, the withdrawn proposal will be returned to the Bidder. Such withdrawn proposals will not be opened or read at the Bid opening. Bids may not be modified after submittal.

10.2 Bids shall be irrevocable for ninety (90) days after the actual day of opening thereof unless the Owner is delayed in awarding the Contract due to the failure to receive a required approval/permit from one or more reviewing bodies/governmental agencies having jurisdiction over the Project, the sale of bonds or the award of a grant, in which case, Bids shall be irrevocable for (120) calendar days after Bid opening. Absent an exception for extending time for the award of the Contract, the Owner and the lowest responsible and responsive Bidder may mutually agree in writing to extend the time for the Owner to award the Contract.

10.3 Neither the designation of the apparent lowest responsible Bidder, nor the issuance of a Notice of Intent to Award to the Bidder so designated shall operate to release any other Bidder from its Bid. Each such other Bidder, unless earlier released from its Bid by specific action of the Owner, shall remain bound by its Bid until the earlier of (1) the date of actual execution by Owner of the Agreement Between Owner and Contractor with the Bidder whom the Award of Contract has been made, or (2) the expiration of the firm Bid period stipulated above.

10.4 Negligence by the Bidder in preparing his Bid confers no right of withdrawal or modification of his proposal after such proposal has been opened. No claims on account of mistakes or omissions of any proposal will be considered. Notwithstanding the above, a Bidder may withdraw his Bid within two (2) business days after the Bid opening time in accordance with the Public Contracts – Withdrawal of Bids Law, Act of January 23, 1974, P.L. 9, No. 4, 73 P.S. §1601 et seq., as amended. A Bid which has been opened may be withdrawn only in accordance with the causes set forth in said Act and for no other reasons. Strict compliance with said Act is required to withdraw a Bid after opening.

10.5 By submitting a bid, the bidder covenants and agrees that he has carefully examined the site, the existing building and details, the documents and the Contract and that, from his own investigations, he has satisfied himself as to the nature and location of the work, the general and local conditions and all matters which may in any way affect the work or its performance and that as a result of such examination, he fully understands the intent and purpose thereof and his obligations thereunder, and that he will not make any claim for, or have any right to, damages because of any lack of information.

10.6 Each bidder is highly encouraged to visit the site to familiarize themselves with the existing conditions thereon pertaining to the work. The bidder shall examine all the documents relating to the Contract on which he is bidding before submitting a Bid. Each Contractor shall obtain the full knowledge by personal and careful inspection of all existing conditions at the site and of all requirements of the Bid Documents that affect the work. The Contractor accepts all such conditions and requirements and hereby assumes all responsibilities and costs resulting from their failure to obtain full knowledge of them.

10.7 The Bids are to include all work as shown or specified, including but not limited to Unit Prices, Alternates and Allowances as may be requested or noted. These prices are important and should be carefully considered when Bids are submitted, and in the form, as quoted, on the Bid forms, attached to these specifications. It is requested upon any bidder, to include all Alternate Bids or Unit Prices. Should any bidder fail to submit requested Alternate Bids or Unit Prices the bidder will be responsible for his omission and shall have no claim against the Owner, should the Owner award the Contract to a bidder who has submitted a more satisfactory and complete bid.

10.8 Any Unit Prices furnished by the Bidder as part of his Proposal Form shall be made a part of the Agreement and shall be the basis of compensation for any Unit Price work required on the Project.

10.9 The Bidder shall identify and list Prior to Award of Contract each Major Subcontractor or material supplier, with their respective prices, to be used on this Project in accordance with the General Conditions of the Contract.

10.10 Bidders shall also secure and submit Major Subcontractors Qualification Statements accordingly as noted below.

10.11 Bidder warrants to execute the Contract, furnish required Bonds in form as incorporated in the contract documents and furnish required insurance certificates and other items, in amounts specified or required, by the owner. Bidder shall also warrant beginning work in accordance with the Project Contract agreement.

10.12 All permits and inspections shall be obtained by each prime contractor and paid for by the owner. The

contractors will be required to pay all license and/ or registration fees by the local community.

10.13 A Waiver of Liens shall be signed by The Contractor as requested by the Construction Manager or prior to the beginning of the ordering of material and before any work is performed on the property. The Waiver of Lien to be filed and indexed in the Bucks County Prothonotary's Office is found as an attachment at the end of these specifications. The Contractor shall provide a Release of Liens for themselves and all suppliers prior to application of final payment.

10.14 All work to be in accordance with applicable codes and ordinances adopted and/or as amended by the local Municipality, and the Commonwealth of Pennsylvania, Pennsylvania Uniform Construction Code, Act 45, The International Code Council, International Building Code – 2021 and Chapter 11 of the IBC 2018.

10.15 This Project falls under the Commonwealth of Pennsylvania Public Works Employment Verification Act, Act 127 of 2012, 43 P.S. § 167.1, which requires all public work contractors and subcontractors to utilize the Federal Government's E-Verify system to ensure that all employees performing work on public work projects are authorized to work in the United States. All Bidders are required to submit a Public Works Employment Verification Form as a precondition for the Contract Award.

10.16 The "Bid Bond," A.I.A. Document No. A310, of the American Institute of Architects, 2010 Edition, is hereby made a part of the Specifications as bound herein. The Bond is subject to all modifications as set forth hereinafter.

10.16.1 A bank cashier's, bank treasurer's certified check or bid bond in favor of Bucks County in the amount of 10% of all base bids plus the amount of all add alternates, is required from each bidder and must be submitted electronically with the bid. It is understood the Bid Deposit will be forfeited to and retained by the owner as liquidated damages if the Proposal, or any part thereof, is accepted by the Owner and the Bidder fails to execute the contract and furnish Bonds within ten (10) days from the date of "Notice of Award". Should the owner fail to make any awards through no fault or failures on the part of the bidders, the Owner shall return said Bid Deposits.

10.16.2 Agreement of Surety: The "Agreement of Surety" form is to be provided to the Owner along with the bid proposal should the bid deposit submitted be other than a "Bid Bond". Attached is a 1-page sample letter to be signed and sealed from a corporate surety agreeing to provide a Performance Bond and Payment Bond in favor of the Owner as required for faithful performance and proper fulfillment of the contract. The Agreement is subject to all modifications as set forth hereinafter.

10.16.3 Non-Collusion Affidavit: The "Non-Collusion Affidavit" form is to be provided to the Owner along with the bid proposal by all prospective bidders. Attached is a document to be signed by all prospective bidders and sealed by notary, assuring the owner that the proposal for work is being submitted in good faith and without collusion with any other contractors or sub-contractors. The Affidavit is subject to all modifications as set forth hereinafter.

10.17 Non-Discrimination/Sexual Harassment Clause: The "Non-Discrimination/Sexual Harassment Clause" form is to be provided to the Owner along with the bid proposal by all prospective bidders. Attached is a document to be signed by all prospective bidders, assuring the owner that the proposal for work is being submitted in good faith and without collusion with any other contractors or subcontractors. The Clause is subject to all modifications as set forth hereinafter.

10.18 Performance and Payment Bonds: The "Performance Bond" and the "Payment Bond," A.I.A. Documents No. A312-2010, of the American Institute of Architects, are hereby made a part of the Specifications as bound herein. The Bonds are subject to all modifications as set forth hereinafter.

10.19 Maintenance Bond – the execution of a maintenance bond is required, per Section 00 4316.

10.20 CONTRACTOR'S QUALIFICATION STATEMENT

10.20.1 Each Bidder is required to submit a Contractor's Qualification Statement (AIA A305-2020) with a sworn statement of his financial responsibility, technical qualifications and evidence

that he has completed at least Five similar construction contracts within the last five (5) years, each with a minimum value of 75% of the total amount of the proposal submitted. In addition, the designated Project Manager and Superintendent must have at least ten (10) years' experience in similar projects with similar values and phased construction. The Owner /Construction Manager has the right to reject a Project Manager or Superintendent if they do not specifically meet the qualifications.

10.21 In the event of a discrepancy between what is inserted on the Building Connected website spreadsheet and the submitted written documentation, the written documents will be deemed controlling.

10.22 Rejection or Withdrawal of Proposals

10.22.1 A bidder on any Prime Contract may withdraw his bid from consideration within forty-eight (48) hours of the bid opening without forfeiture of the certified check, bank cashier's check, surety bid bond or other security filed with the bid if the price bid was submitted in good faith, and the bidder submits credible evidence that the reason for the price bid being substantially lower was a clerical mistake as opposed to a judgment mistake, and was actually due to an unintentional and substantial arithmetical error or an unintentional omission of a substantial quantity of work, labor, material or services made directly in compilation of the bid; provided, 1.) the mistake or error must be proven and submitted to the Owner / Construction Manager for review and approval: 2.) notice of a claim of the right to withdraw such bid is made in writing with the contracting body within two business days after the opening of bids; and 3.) the withdrawal of the bid would not result in the awarding of the contract on another bid of the same bidder, his partner, or to a corporation or business venture owned by or in which he has a substantial interest.. No bidder who is permitted to withdraw a bid shall supply any material or labor or perform any subcontract or other work on the project without written approval of the contracting body. No accepted bid may be withdrawn for ninety (90) calendar days after the Bid Opening. Initial determination as to whether there was a clerical mistake or arithmetical error or unintentional omission of substantial quantity of work, labor, material, or services will be within the discretion of the Architect, a representative of the Owner, with the assistance of the Construction Manager, and such decision shall be considered final and determinative.

10.22.2 Bids may be modified or withdrawn within Building Connected at any time prior to the due date and time listed in the Invitation to Bid.

10.22.3 The School District reserves the right to reject any bid received if the bidder's responses to the Contractor's Qualification Statement (AIA Document A305) fail to satisfy the School District that such bidder is qualified to carry out the obligations of the Contract and to complete work, as specified. By way of specific example, a default in a contract in the last five years will, absent extraordinary justification, disqualify a bidder, as will litigation on a construction contract which, in the past five years, resulted in an award against the interest of the bidder.

11 PA PREVAILING WAGE

11.1 The Schedule of Minimum Wages as determined by the Department of Labor and Industry, Commonwealth of Pennsylvania, is hereby made a part of this Specification. A copy of these rates is attached in Section 007343 Prevailing Wage Requirements.

11.2 Copies of these forms may be obtained from the Prevailing Wage Division. The Project is subject to the Pennsylvania Prevailing Wage Act (Act of 1961, P.L. 987 No. 442) as amended. The pages titled, "Duties of Awarding Agencies Under Pennsylvania Prevailing Wage Act" may be obtained from the Prevailing Wage Division. These duties include requirements of both the awarding agency (Owner), the Contractor(s) and Subcontractors. It is understood that the Owner will comply with its required duties. The Contractor(s) and Subcontractors shall comply with all duties and instructions required of them. All items mentioned as "contract requirements" in the documents are hereby made a part of the contract to the same extent as if included in the Owner-Contractor Agreement.

11.3 "Payroll Certification for Public Works Projects". All Contractors and Subcontractors shall complete this form for each week worked on this project. Each Weekly Payroll Certification form shall be Notarized and forwarded to the Construction Manager for inclusion in the Owner's records. Payroll Certification Forms covering work periods included in an application for payment shall be submitted before or with the respective Application For Payment. If the certifications Forms are not submitted with the Application for Payments, the Owner will withhold payment until received.

11.4 US Steel Act 132. The Steel Products Procurement Act, 73 P.S. §§1881-1887, and the Trade Practices Act, 71 P.S. §773.101 et seq.

11.4.1 If any steel products are to be used or supplied in the performance of the Contract, only steel products produced in the United States shall be used or supplied in the performance of the Contract or any subcontract thereunder. This provision shall not apply in any case where the head of the public agency, in writing, determines that the type of steel products necessary to the performance of the Contract are not produced in the United States in sufficient quantities to meet the requirement of the Contract.

11.4.2 Contractors must ensure compliance with all provisions of the above which place restrictions upon the source of certain steel, cast iron and aluminum products allowed to be used in the performance of public agency contracts. The provisions of the above sited statutes are incorporated herein as if the same were set out at length herein.

11.4.3 Bidding will be public and utilize Pennsylvania State Prevailing Wage Rates established by the Commonwealth of PA Department of Labor and Industry.

12 INDEMNITY

12.1 The undersigned shall indemnify and hold harmless Council Rock School District, Boyle Construction, Inc., Marotta / Main Architects, and all consultants and each officer and employees for those indemnified, with respect to any claims, losses, expenses, costs and reasonable attorney's fees incurred by Council Rock School District, Boyle Construction, Inc., Marotta / Main Architects, and all consultants and each officer and employees, for those indemnified, with regard to the undersigned's failure to comply with these Bid Documents and procedures.

12.2. Additional Insureds: All shall be named as "Additional Insureds" under all policies of insurances. Coverage shall be primary and non-contributory.

1. Council Rock School District, its members, officers, employees and consultants.
2. Boyle Construction, Inc., Marotta / Main Architects, and their members, officers, employees and consultants.
3. Newtown Borough and its employees.
4. Bucks County Conservation District.

13 Extra Work – No extra work will be considered unless the Council Rock School District authorizes such work, in advance, in writing.

14 Safety and Health Regulations – The Bidder further agrees that should he enter into a Contract with the Council Rock School District to perform all or any portion of the work included herein, he will comply with all the provisions of the Department of Labor, Occupational Safety and Health Administration, Safety and Health Regulations for Construction, contained in the Federal Register Volume 37, Number 243, Part II, dated Saturday, December 16, 1972.

15 SPECIFICATION AND PRODUCT DESCRIPTION

15.1 Substitute Material and Equipment – Proposal shall include furnishing and installing material in strict accordance with Contract Documents. No substitutions or deviations will be considered except as provided for in Contract Documents

15.2 Any product substitution requests must be made in writing including all product literature

and specification at least ten (10) calendar days prior to the bid due date. The Owner will not accept mechanical substitutions after the bid opening date.

16 This project is financed by Council Rock School District.

17 OPENING OF PROPOSALS

17.1 The Owner will, as soon as practical, award the Contracts to the Bidders, and shall have the right to reject any or all Bids, to waive technical defects, and to accept or reject any part of any Bid if in the judgment of the Owner its best interest shall be served by such action; and the Bidder, in submitting a Bid accepts these conditions. No rights shall accrue to any person submitting a Bid or Proposal until such Bid has been accepted, and a contract awarded, and such contract completely executed in writing by both parties.

18. AWARD OF CONTRACT

18.1 The Owner's intent is to enter into Contracts with the lowest responsible and qualified Bidders.

18.2 The Owner reserves the right to reject any and all bids. The Owner reserves the right to waive non-material defects, informalities or technicalities in any Bid in accordance with law. The Owner reserves the right to disregard all nonconforming, non-responsive, unbalanced, or conditional bids. Also, Owner reserves the right to reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Project to make an award to that Bidder, whether because the Bid is not responsive, or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by the Bidding Documents.

18.3 In evaluating Bids, Owner will consider the qualifications of such Bidders (see Article 3), whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data, as may be requested in the Bid Form or prior to the Notice of Award.

18.4 Owner may consider the qualifications and experience of Subcontractors, suppliers, and other persons or organizations proposed for any portions of the Work requested by Owner. Owner also may consider the operating costs, maintenance requirements, performance data, and guarantees of major items of materials and equipment proposed for incorporation in the Work when such data is required to be submitted prior to the Notice of Award.

18.5 Owner may conduct such investigations as Owner deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualification, and financial ability of Bidders, subcontractors, suppliers, and other persons or organizations to perform and furnish the Work in accordance with the Contract Documents to Owner's satisfaction within the prescribed time.

18.6 If the Contract is to be awarded, Owner will give the Successful Bidder a Notice of Intent to Award within sixty (60) days after the day of Bid opening unless extended as set forth in these Instructions to Bidders.

18.7 The Owner reserves the right to waive non-material defects, informalities, or technicalities in any Bid in accordance with the law.

19. CONTRACT SECURITY & INSURANCE

19.1 The General Conditions set forth the Owner's requirements as to Performance Bonds,

Payment Bonds, and insurance requirements.

19.2 The apparent low Bidder must provide Payment and Performance Bonds in the forms included in the Contract Documents and all Certificates of Insurance or other insurance information as required pursuant to the General Conditions of the Contract within ten (10) days of the issuance of Notice of Intent to Award. **Other bond forms will not be accepted**. Failure of the apparent low Bidder to provide original executed Payment and Performance Bonds in the required form within the required time will result in forfeiture of the Bid Security.

20. SIGNING OF AGREEMENT

When Owner/Construction Manager issues a Notice of Intent to Award to the Successful Bidder, the Successful Bidder shall within ten (10) days thereafter, deliver to the Owner/Construction Manager, one (1) original copy of the required bonds, insurance certificates, and any other documents that may be requested with the Notice of Intent to Award. Within ten (10) days thereafter, the Construction Manager will send contract agreements via DocuSign to Successful Bidder. The Successful Bidder shall sign the agreements and DocuSign will automatically send the agreements to the Owner for signature. Once signed by the Owner DocuSign will automatically return an executed agreement to all parties.

21. RETAINAGE

Retainage will be in accordance with the Contract Documents. Reference Article 9 of the General Conditions.

22. PREVAILING WAGES

Pennsylvania Prevailing wage rates will apply to this project. The Contractor and its subcontractors shall comply with the provisions, duties, obligations, remedies, and penalties of the Pennsylvania Prevailing Wage Act, 43 P.S. § 165-1 et seq. which is incorporated herein by reference as if fully set forth herein. The general prevailing minimum wage rates, as determined by the Secretary of Labor and Industry shall be paid for each craft or classification of all workmen needed to perform work on the Project during the term hereof for the locality in which the work is to be performed.

23. COMPETENT WORKMEN

No person shall be employed to perform any work under the Contract if they are not legally eligible to be employed under applicable state and federal law or if they are not a trained, competent workman, or mechanic, as applicable. For purposes of this Section, no workman or mechanic, as applicable, shall be regarded as competent unless he shall be duly skilled in the applicable branch of labor, and paid the applicable prevailing wage.

23.1 The Commonwealth of Pennsylvania enacted Act 127 of 2012, known as the Public Works Employment Verification Act ('the Act') which requires all public work contractors and subcontractors to utilize the Federal Government's E-Verify system to ensure that all employees performing work on public work projects are authorized to work in the United States. The Contractor and its Subcontractor (as such term is defined in the Act) are required to comply with the Act and the Statement of Policy as published in the Pennsylvania Bulletin, December 29, 2012, and effective January 1, 2013.

23.2 Criminal History and Child Protective Service Information: Prior to commencing the Work, the Contractor shall supply the Owner with state and federal criminal history reports and child abuse clearances for all employees, agents, and Subcontractors who will be on the Owner's property.

24. EROSION CONTROL

The Successful Bidders shall comply with all rules and regulations of Chapter 102, Title 25 of Pennsylvania Code, relating to Soil Erosion and Sedimentation Control.

25. PUBLIC WORKS CONSTRUCTION CONTRACTS

In consideration of the funds awarded and activities funded under the Contract which involves construction, reconstruction, alteration, repair, improvement, or maintenance of a building, structure, or improvement ("The Work"), the Successful Bidder agrees to perform in accordance with the following:

25.1 Steel Products Procurement Act.

25.2 Trade Practices Act.

25.3 Public Works Contractor's Bond Law of 1967. Prior to the award of any Contract for any Work on the Project, the contractor to whom the contract is to be awarded must furnish the following bonds which shall become binding upon the award of such Contract:

25.3.1 A performance bond at 100 percent of the Contract Sum, conditioned upon the faithful performance of the Contract in accordance with the plans, specifications, and conditions of the Contract. Such bond shall solely for the protection of the Owner which awarded said contract.

25.3.2 A payment bond at 100 percent of the Contract Sum. Such bond shall be solely for the protection of claimants supplying labor or materials to the Successful Bidder, its contractor(s) or to any of its Subcontractors, in the prosecution of the work provided for in such Contract and shall be conditioned for the prompt payment of all such material furnished or labor supplied or performed in the prosecution of the Work. "Labor or materials" shall include public utility services and reasonable rentals of equipment, but only for periods when the equipment rented is actually used at the site.

25.3.3 Reference Article 11.1.2 of the General Conditions for additional requirements.

26. SEVERABILITY

26.1 Should any section or any part of any section of the Contract be rendered void, invalid, or unenforceable by any court of law, for any reason, such a determination shall not render void, invalid, or unenforceable any other section or part of any section of the Contract.

27. AMERICANS WITH DISABILITIES ACT

During the term of this Contract, the Successful Bidder agrees as follows:

27.1 Pursuant to federal regulations promulgated under the authority of The Americans with Disabilities Act, 28 C.F.R. § 35.101 et. Seq., the Successful Bidder understands and agrees that no individual with a disability shall, on the basis of the disability, be excluded from participation in this Contract or from activities provided for under this Contract. As a condition of accepting and executing the Contract, the Successful Bidder agrees to comply with the General Prohibitions Against Discrimination, 28 C.F.R. § 35.130, and all other regulations promulgated under Title II of The Americans with Disabilities Act which are applicable to all benefits, services, programs, and activities provided by the Commonwealth of Pennsylvania through contracts.

28. HEALTH AND SAFETY

28.1 Reference Article 10 of the General Conditions.

29. BONDS & INSURANCE

29.1 The Bidder will be required to furnish a Bid Bond, Performance Bond, and Labor and Material Payment Bonds in the amount of one hundred percent (100%) of the Contract Price in the form provided in the Contract Documents. Said Sureties shall be listed on the current Federal Register and have an AM Best rating of 'A-' or better and a financial rating of Class X or higher.

29.2 Insurance companies must be rated 'A-' or better in A.M. Best.

29.3 Bidder shall include the cost of the Bonds & Insurance in their Bid.

29.4 Bidder shall provide the insurance required in the General Conditions.

30. PRE-BID CONFERENCE

30.1 The Mandatory Pre-bid Conference will be held on the date and time listed in the Advertisement for Bids. Representatives of Owner, Construction Manager, and Architect will be present to discuss the Project. Construction Manager will transmit to all prospective Bidders of record such Addenda, as Construction Manager considers necessary in response to questions arising at the Conference.

31. PROJECT FINANCING

The Work to be done under the Contract is public work and may be financed in whole or part by the Owner (a public body) by issuance of bonds, which are subject to various qualifications and restrictions. The Owner, in such case and in good faith, intends to consummate such financing, but its ability to do so is subject to many factors beyond its control. It is therefore expressly understood and agreed to by each Bidder that, notwithstanding any other provision of the Contract Documents, the Owner may at any time cancel any award made by it, or cancel any contract entered into with any Bidder, without liability to the Bidder, at any time before the Bidder has been given written notice to proceed and has actually begun Work under the Contract if financing satisfactory to the Owner cannot reasonably be consummated as contemplated, or if any court of competent jurisdiction shall enjoin or otherwise prohibit the Owner from proceeding with the Work.

32. FAILURE TO EXECUTE CONTRACT

Failure of the Successful Bidder to whom Notice of Intent to Award has been given to deliver appropriate Payment and Performance Bonds, Certificates of Insurance, or execute the Contract within the time specified, shall constitute a default by such Bidder and the Owner may, at its sole discretion, award the contract to the next lowest responsive and responsible Bidder or re-advertise for Bids, and the defaulting Bidder shall pay to the Owner the difference between the amounts of his Bid and any higher amount for which the Owner may contract for the required work, plus any advertising, consulting, legal or other expenses incurred by reason of the default. The Bid Security of such defaulting Bidder shall be applied on account of said damages, and if the amount of said damages exceeds the amount of the Bid Security, the defaulting Bidder shall pay to the Owner the full amount of the excess.

END OF SECTION 00 11 00

SECTION 00 11 10 – PROJECT DIRECTORY

Council Rock School District
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This information is provided for the convenience of all parties and may be subject to change. All contacts shall be made through Boyle Construction, Inc.

Bid Schedule

Project Documents Out to Bid	Tuesday, October 13, 2026
Advertisement #1	Tuesday, September 29, 2026
Advertisement #2	Tuesday, October 6, 2026
Advertisement #3	Tuesday, October 13, 2026
Mandatory Pre-Bid Meeting	Tuesday, October 20, 2026
Final Day to Submit RFIs via Building Connected	Tuesday, November 3, 2026, by 5:00 pm EST
Final Addendum Issued to Bidders	Friday, November 6, 2026
Accept Bids/Bid Opening	Thursday, November 17, 2026, by 2:00pm
BCI De-Scope Bids and Bid Tab Preparation	Thursday, Nov. 17, 2026 - Monday, Nov. 30, 2026
BCI Recommendation of Award Letter	Monday, November 30, 2026
Present Recommendation to Facilities Committee	Thursday, December 10, 2026
School Board Meeting to Award Bids	Thursday, December 17, 2026
BCI Letters of Intent to Award to Contractors	Friday, December 18, 2026
Contracts, Bonds, COI, etc.	Friday, December 18, 2026 - Monday, January 4, 2027
Notice to Proceed Issued (anticipated)	Monday, January 4, 2027

SECTION 00 11 13 – ADVERTISEMENT FOR BIDS

The Council Rock School District will receive sealed bids for the Chancellor Center Renovations Project located in Bucks County, Pennsylvania. Sealed Bids for all contracts shall be delivered to Jessica Weiss, Purchasing Secretary, no later than 2:00 PM prevailing time on Tuesday, November 17, 2026, to the Chancellor Center, 30 N. Chancellor Street, Newtown, PA 18940, at which time bids will be publicly opened and read.

A **MANDATORY** pre-bid conference for **ALL** contracts will be held **IN-PERSON**, on Tuesday, October 20, 2026, **at 3:00 PM** at the Chancellor Center, located at 30 N. Chancellor Street, Newtown, PA 18940. **Attendance of all Prime Contract Bidders is mandatory.**

Construction will be bid for the following Prime Contracts:

GENERAL/SITE CONSTRUCTION - BP-01
PLUMBING/FIRE PROTECTION CONSTRUCTION - BP-02
MECHANICAL CONSTRUCTION - BP-03
ELECTRICAL CONSTRUCTION - BP-04
ABATEMENT CONSTRUCTION - BP-05

Bid Documents will be available at no cost through Building Connected at 1:00 PM prevailing time on Tuesday, October 13, 2026. Bidders may obtain electronic access to the documents by contacting Tracey Glad via email at tglad@boyleconstruction.com.

All bids must be accompanied by a certified check or bank draft, payable to Council Rock School District, or a satisfactory Bid Bond executed by the Bidder and an acceptable surety in the amount equal to ten percent (10%) of the total bid shall be submitted with each bid, along with all required items as indicated in the Bid Documents checklist. Performance and Payment Bonds will be required from the lowest responsible bidders at a later date along with all other required documentation.

The Project Architect is Marotta / Main Architects, 214 North Duke Street, Lancaster, PA 17602. The Project Construction Manager is Boyle Construction, 3850 Sierra Circle, Suite 400, Center Valley, PA 18034. The Environmental Consultant is Element Environmental Solutions, 61 Willow Street, P.O. Box 921, Adamstown, PA 19501.

This project is subject to the provisions of the PA Prevailing Wage Act.

The awards will be made to the lowest responsible and responsive bidder submitting a bid in conformity with the specifications. However, the District reserves the right to reject any or all bids.

By Order of the Board of School Directors
Council Rock School District
Dr. Andrew J. Sanko, Superintendent

Adv #1: Tuesday, September 29, 2026
Adv #2: Tuesday, October 6, 2026
Adv #3: Tuesday, October 13, 2026

END OF SECTION 00 11 13

SECTION 00 11 55 – LETTER OF INSURER

DATE: _____

TO: Dr. Andrew Sanko, Superintendent
Council Rock School District
30 N. Chancellor Street
Newtown, PA 18940

Dear Dr. Sanko:

The undersigned insurance agent, licensed to do business in the Commonwealth of Pennsylvania and authorized to issue this letter on behalf of the following insurance company or companies:

_____

_____

hereby represents that if

_____
(Insert name of Bidder)

is awarded the contract for the construction of the project, as is described in the Contract for Construction, then the above-named insurance company or companies will issue insurance, naming the Council Rock School District and its consultants, Boyle Construction, Inc. and all consultants, Marotta / Main Architects and all consultants, the Bucks County Conservation District, Newtown Borough and its consultants, its employees, officers, and agents, and each of the above named officers, agents, and employees as additional insured, for the coverages and in the amounts required by the Contract Documents, as set forth in Article 11 of the General Conditions.

_____
(Name of Agent)

By: _____
(Authorized Representative)

Council Rock School District
Chancellor Center Renovations
30 North Chancellor Street
Newtown, PA 18940

Bid Form
Bid Package #01 – General/Site Construction

Bids Due: 11/17/26 @ 2:00 PM

Deliver Sealed bids to:
Council Rock School District
Attn: Jessica Weiss, Purchasing Secretary
Chancellor Center
30 North Chancellor Street
Newtown, PA 18940

Date: _____

Firm Name: _____

Firm Address: _____

_____

Contact: _____

Phone Number: _____

Email: _____

THIS BID FORM SHALL NOT BE ALTERED IN ANY MANNER. ANY ALTERED BID FORMS SHALL BE CONSIDERED NON-RESPONSIVE AND WILL BE REJECTED.

This Bid is submitted in accordance with your Advertisement inviting bids to be received for the Council Rock School District Chancellor Center Renovations Bid Package #01 General/Site Construction.

The undersigned BIDDER proposes and agrees, if this Bid is accepted, to enter into an Agreement with OWNER in the form included in the Contract Documents to complete all Work as specified or indicated in the Contract Documents for the Contract Price and within the Contract Time indicated in this Bid and in accordance with the Contract Documents.

In submitting this Bid, BIDDER represents, as more fully set forth in the agreement that:

a. BIDDER has carefully examined the Contract Documents including all Addenda which are incorporated with these documents indicating various conditions affecting this contract, the undersigned herein agrees to furnish all materials, perform all labor and do all else necessary to complete the work for the Bid Package #01 indicated above for the Contract for the above named Project in accordance with said Contract Documents.

b. BIDDER has examined the site and locality where the Work is to be performed, the legal requirements (federal, state, and local laws, ordinances, rules and regulations) and the conditions affecting cost, progress or performance of the Work and has made such independent investigations as BIDDER deems necessary. Failure to visit and not be familiar with the Project site shall be no reason for future requests for additional compensation or costs of any kind.

LUMP SUM BASE BID – The contractor shall state the price for the completion of all work as indicated by the Contract Documents that is not included in the bid alternates listed below. This price shall be the base bid. **The base bid below shall include any and all allowances as described below**. All allowances MUST include all overhead and profit.

	BASE BID LINE ITEM SUB-TOTALS	
	Line Item Scope of Work	**Line Item Scope of Work Bid Subtotal**
BB1	Contractors' Cost of Work	Words: _____Dollars Figures: ($_____)

BB2	**Unit Price No.**	**Contractor's Unit Price Bid**	**Bid Quantity**		**Unit Price Allowance (UPA) Amount** ***(To be included in Base Bid)***
	Unit Price No. 1 – Hydraulic Cement Underlayment: One unit is defined as one square foot of additional hydraulic cement underlayment over existing slabs, depths to range from 0.5 to 1.5 inches. Include cementitious self-leveling floor underlayment and primer, including floor preparation, on existing floors.	$_____/ SF	4000 SF		**Unit Price Allowance No. UPA-1** **$**_____
	Unit Price No. 2 – GWB/Stud Partition (Type P4): One unit is defined as providing and installing one linear foot of the following assembly: 10'-0" high metal stud partition wall construction (3 5/8" metal studs with 5/8" GWB on EACH side, filled with batt insul.), painted finish PNT-1, as directed by Architect.	$_____/ LF	100 LF		**Unit Price Allowance No. UPA-2** **$**_____
	Unit Price No. 3 – GWB Bulkhead: One unit is defined as providing and installing one linear foot of additional bulkhead construction assembly, in accordance with Detail 3/A6.2, as directed by the Architect.	$_____/ LF	100 LF		**Unit Price Allowance No. UPA-3** **$**_____
	Unit Price No. 4 – Plaster Patching: One unit is defined as providing and installing one square foot of additional plaster patching as directed by the Architect. Refer to Detail 6/A1.0 and "Existing Plaster Repair Scope" notes on Drawing A1.0.	$_____/ SF	500 SF		**Unit Price Allowance No. UPA-4** **$**_____
	Unit Price No. 5 – Unsuitable Soils Removal and Replacement: One unit is defined as one cubic yard of naturally occurring soil determined by the Geotechnical Engineer to be unsuitable, including excavation, removal and				

	disposal, furnishing suitable soil, engineered fill, or 2A stone from on-site or off-site sources as required, placement, moisture conditioning, and compaction of replacement materials, complete in accordance with Division 31 Section "Earthwork."	$_____/ CY	250 CY		**Unit Price Allowance No. UPA-5** **$**_____
	Unit Price No. 6 Replacement Fill for Additional Excavation with Borrow Material: One unit is defined as one cubic yard of in-place material. Where authorized additional excavation occurs, provide replacement fill of satisfactory soils from an off-site source, placed and compacted, in accordance with Section 31 20 00 “Earth Moving”.	$_____/ CY	250 CY		**Unit Price Allowance No. UPA-6** **$**_____
	Unit Price No. 7 – Exterior Concrete Slab Removal and Replacement: One unit is defined as one square foot. Remove existing concrete slab. Existing underslab utilities to remain unless noted otherwise. Excavate earth to depth required to install slab assembly replacement. Replace with drainage bed and reinforced concrete slab.	$_____/ SF	50 SF		**Unit Price Allowance No. UPA-7** **$**_____
	Unit Price No. 8 – Miscellaneous Steel: Furnish and install miscellaneous steel for lintels; roof openings, headers, miscellaneous angles, beams, plates, bars, etc.	$_____/ TON	1 TON		**Unit Price Allowance No. UPA-8** **$**_____
	Unit Price No. 9 – Demolish And Replace Mountable Concrete Curb Gutter: One unit consists of one linear foot of the following scope of work: Remove existing rolled mountable concrete curb gutter. Excavate, form, and install new rolled mountable concrete curb gutter on site.	$_____/ LF	50 LF		**Unit Price Allowance No. UPA-9** **$**_____
	Unit Price No. 10 – Exterior Concrete Sidewalk: One unit consists of one square foot of the following assembly: Exterior concrete sidewalk or flatwork including excavation, and consisting of 4" 2A modified stone base and 4" reinforced exterior concrete.	$_____/ SF	100 SF		**Unit Price Allowance No. UPA-10** **$**_____
	Unit Price No. 11 – Full-Depth Asphalt Paving: One unit consists of: One square yard of bituminous asphalt paving in one defined contiguous area, including excavation, and consisting of 8" 2A modified stone base, 3" binder course (SuperPave 19 mm) and				

	1-1/2" wearing course (SuperPave 9.5 mm).	$_____/ SY	200 SY		**Unit Price Allowance No. UPA-11** **$**_____
	Unit Price No. 12 – Mill & Overlay Existing Asphalt Paving Repair: One unit consists of: One square yard of the following scope of work: Mill existing asphalt pavement to a depth of 1-1/2", tack, and overlay up to 5 square yards in one defined contiguous area with 1-1/2" of 9.5 mm SuperPave wearing course.	$_____/ SY	400 SY		**Unit Price Allowance No. UPA-12** **$**_____
	Unit Price No. 13 – Existing Wood Floor Repair: One unit is defined as one square foot of the following scope of work: Remove existing damaged wood flooring as directed by Architect. Replace with new flooring as described in the Construction Documents.	$_____/ SF	200 SF		**Unit Price Allowance No. UPA-13** **$**_____
	Unit Price No. 14 – Existing Exterior Wall Repair: One unit is defined as one square foot of existing exterior masonry or stone wall repair as described in the Construction Documents.	$_____/ SF	200 SF		**Unit Price Allowance No. UPA-14** **$**_____
	Unit Price No. 15 – Existing Exterior Mortar Repointing: Provide additional exterior repointing beyond what is shown in the Construction Documents. Comply with requirements for Division 04, Sections 04 03 23 and 04 03 43. Assume repointing will be completed in small quantities (±100 S.F.).	$_____/ SF	1000 SF		**Unit Price Allowance No. UPA-15** **$**_____
	Unit Price No. 16 - Contaminated Soil Removal and Disposal at a Regulated Fill Site: One unit is defined as one cubic yard of soil which has been tested on-site by Owner's third-party Construction Testing Agency and determined to be contaminated. Remove tested, contaminated soil and dispose of at a regulated fill site.	$_____/ CY	250 CY		**Unit Price Allowance No. UPA-16** **$**_____

TOTAL LUMP SUM BASE BID Contractors' Cost for the Work (**BB1**) + Unit Price Allowances (**BB2**)
Words:_____Dollars
Figures: ($_____)

Accompanying this Proposal is a certified check, bank cashier's check, bank treasurer's check or Bid Bond required by the Checklist and Instructions to Bidders, in the amount of 10% of the total Base Bid plus ALL possible ADD Alternates, which is deposited as a proposal guarantee, and is to be retained by you and applied as provided in the Instruction to Bidders, in case the undersigned shall default in executing the Contract or in furnishing the required Bonds and insurance certificates within the time specified by the Contract Documents.

The undersigned hereby certifies that this Proposal is genuine and not sham or collusive or made in the interest of or in behalf of any person, firm or corporation not herein named and that the undersigned has not directly or indirectly induced or solicited any bidder to refrain from bidding and that the undersigned has not in any manner sought by collusion to secure for himself any advantages over any other bidder.

The undersigned, intending to be legally bound, agrees that this Proposal shall be irrevocable and shall remain subject to your acceptance for 90 days after date set for bid opening unless the Owner is delayed in awarding the Contract due to the failure to receive a required approval or permit from one or more reviewing bodies/governmental agencies having jurisdiction over the Project, the sale of bonds, or the award of a grant, in which case, Bids shall remain open for 120 days after the day of Bid Opening. BIDDER will sign the Agreement and submit the Contract Security and other documents required by the Contract Documents within ten (10) days after the date of OWNER'S Notice of Award, except as provided by Act 317 of 1978, approved November 26, 1978, which provides for possible extensions of the holding period.

The undersigned submit this Proposal with the full knowledge of the Contract Document and Project requirements and hereby agrees that each phase of the work of this Project, under this Contract, shall be fully and finally completed and ready for occupancy and use on or before the completion date identified for that specific phase in the Contract Documents.

Bidder accepts the provisions of the Agreement as to the liquidated damages for failure to meet the milestone dates defined and substantial completion of the project shall be calculated at Two Thousand Dollars ($2,000.00) per day for each calendar day of delay until the work is substantially complete.

The contract amount stated above includes all sales taxes, excise, and other taxes for all materials and appliances subject to and upon which taxes are levied.

The undersigned must enclose the following required attachments to this Bid Form. **Each bidder shall submit one (1) hard copy of the complete bid submission.**

The following shall be included in the bid submission:

1. Form of Proposal, fully executed and notarized
2. Bid Bond or Certified Check or Cashier's check in the amount of 10% of the Bid total and shall include Consent of Surety and Power of Attorney
3. Non-Collusion Affidavit, Signed and Sealed
4. Non-Discrimination Clause, Signed and Sealed
5. PA Public Works Employment Verification Form (E-Verify)

Note that the following will be required to be submitted by ALL Bidders at the request of the Construction Manager within 48 hours of bid submission:

1. Bidder's Qualifications, AIA A305, completed
2. Schedule of Values
3. List of Subcontractors
4. Safety Questionnaire

Note that the successful bidder will be required to submit the following documents and any other documents deemed necessary by the Construction Manager upon issuance of Letter of Intent to Award:

1. Certificate of Insurance
2. Performance Bond in the amount of 100%
3. Payment Bond in the amount of 100%
4. No Lien Agreement
5. Maintenance Bond

The undersigned shall indemnify and hold harmless Council Rock School District, Boyle Construction, Inc., and Marotta / Main Architects, all consultants and each officer and employees, with respect to any claims, losses, expenses, costs and reasonable attorney's fees incurred by Council Rock School District, Boyle Construction, Inc., Marotta / Main Architects, all consultants and each officer and employees, with regard to the undersigned's failure to comply with these Bid Documents and procedures.

Permits and Inspections: Any required permit fee will be paid by the Owner. Upon award, the successful prime contractor

must complete any applicable permit form (and business licenses if required) and submit to the Borough. Inspection fees will be paid for by the Owner. Any additional costs incurred due to failed inspections shall be paid by the prime contractor. Any required contractor or business license fees required by the Borough are to be paid by the prime contractor.

The Owner also reserves the right to solicit independent proposals as required by Council Rock School District guidelines, under a separate contract to perform the services required. **The responsiveness of the Bid and if the Bid is responsible, may be determined by the Owner on the basis of the Unit Prices proposed by the bidder. Unit Prices shall be consistent with verifiable average costs for the work to be performed. Bidders agree that a proposal may be rejected if the Unit Prices submitted are inconsistent with the average cost.** Under NO circumstances will BIDDER perform Unit Price Work without prior written authorization from the OWNER. Contract Unit Price shall include costs for furnishing and installing all materials, labor, tools, equipment, and other incidentals necessary to complete the specified operation. Contract Unit Price shall also apply to deletion of "furnishing and installing" items from the Project.

In submitting this Bid, it is understood that the OWNER reserves the unrestricted right to reject any and all bids, or to waive any informalities or technicalities in said Bids.

UNIT PRICE ALLOWANCES: The Contractor must provide a change in scope of work (no change in Contract Sum or Contract Time) Change Order for the allowance work, indicating the allowance amount to be utilized, in which the Construction Manager (CMa) must review with the Owner and approve prior to the Contractor performing the Work. Should the allowance amount be exceeded and the Work approved to be performed, the Contractor will provide a Change Order for the additional Work and only be paid by an approved Change Order for the additional related Work. Similarly, should the allowance used be less than the allowance amount, the Contractor will credit the Owner for the unused allowance amount by a Change Order credit. All OH&P for allowances MUST be included within the Base Bid of the Project. NO additional OH&P will be allowed in allowances. Change Orders for the utilization of allowances shall not include OH&P. Change Orders for additional Work exceeding allowance amounts shall include OH&P. Change Orders for credit of unused allowance amounts shall be provided with OH&P in addition to the remaining allowance amount. OH&P for all stipulations noted above is to be a maximum of 5% combined.

ALTERNATES: The Bidder agrees that the Owner shall have the right to accept or reject any or all of the following alternates, which acceptance or rejection shall enter into the determination of the lowest Bidder. The Bidder agrees that the Contract Time shall not be increased on account of the acceptance of any one or combination of alternates unless specifically stated in such alternate description(s). The Bidder agrees that the Owner shall have the right to accept an alternate that is higher in price than the Base Bid or other alternate. Alternates' prices shall include the cost of furnishing and installing all materials, labor, tools, equipment and other incidentals necessary to complete the Work in accordance with the design intent, manufacturers' recommendations, building codes, authorities having jurisdiction, and the Construction Documents. Do not adjust material allowances under any alternate bid items. Indicate whether alternate cost is an Add or Deduct when a choice is provided. If there is no change in the contract amount for any alternate write "NO CHANGE" or "Zero (0)" in the blank. The failure to enter an amount or "NO CHANGE" in the blanks for an alternate shall be treated conclusively as a Bid of zero dollars for the work described in the alternate.

Alternate #1: The Bidder shall state the adjustment in price to be added to or deducted from the Base Bid to increase the Contractor's Warranty period from one-year to two-year from the date of substantial completion (excluding landscaping). This alternate does not affect other warranties required by the Contract Documents or provided by manufacturers.

ADD/DEDUCT_____Dollars.
(Words)

($ _____)
(Figures)

The undersigned hereby acknowledge receipt of following Addenda and has prepared this bid accordingly:

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

SIGNATURES:

In witness whereof, the undersigned has caused this Proposal to be executed this _____ day of _____, 20_____.

INDIVIDUAL, PARTNERSHIP, LLC OR CORPORATION

_____
(Firm Name)

By: _____
(Signature)

_____
(Print Name and Title of Authorized Person to Sign)

State of Incorporation: _____

Business Address: _____

_____

_____

Telephone Number: _____

Email Address: _____

_____
Attest By

_____
Print Name of Person

Business/Corporate Seal:

Council Rock School District
Chancellor Center Renovations
30 North Chancellor Street
Newtown, PA 18940

Bid Form
Bid Package #02 – Plumbing/Fire Protection Construction

Bids Due: 11/17/26 @ 2:00 PM

Deliver Sealed bids to:
Council Rock School District
Attn: Jessica Weiss, Purchasing Secretary
Chancellor Center
30 North Chancellor Street
Newtown, PA 18940

Date: _____

Firm Name: _____

Firm Address: _____

_____

Contact: _____

Phone Number: _____

Email: _____

THIS BID FORM SHALL NOT BE ALTERED IN ANY MANNER. ANY ALTERED BID FORMS SHALL BE CONSIDERED NON-RESPONSIVE AND WILL BE REJECTED.

This Bid is submitted in accordance with your Advertisement inviting bids to be received for the Council Rock School District Chancellor Center Renovations Bid Package #02 Plumbing/Fire Protection Construction.

The undersigned BIDDER proposes and agrees, if this Bid is accepted, to enter into an Agreement with OWNER in the form included in the Contract Documents to complete all Work as specified or indicated in the Contract Documents for the Contract Price and within the Contract Time indicated in this Bid and in accordance with the Contract Documents.

In submitting this Bid, BIDDER represents, as more fully set forth in the agreement that:

a. BIDDER has carefully examined the Contract Documents including all Addenda which are incorporated with these documents indicating various conditions affecting this contract, the undersigned herein agrees to furnish all materials, perform all labor and do all else necessary to complete the work for the Bid Package #02 indicated above for the Contract for the above named Project in accordance with said Contract Documents.

b. BIDDER has examined the site and locality where the Work is to be performed, the legal requirements (federal, state, and local laws, ordinances, rules and regulations) and the conditions affecting cost, progress or performance of the Work and has made such independent investigations as BIDDER deems necessary. Failure to visit and not be familiar with the Project site shall be no reason for future requests for additional compensation or costs of any kind.

LUMP SUM BASE BID – The contractor shall state the price for the completion of all work as indicated by the Contract Documents that is not included in the bid alternates listed below. This price shall be the base bid. **The base bid below shall include any and all allowances as described below**. All allowances MUST include all overhead and profit.

	BASE BID LINE ITEM SUB-TOTALS	
	Line Item Scope of Work	**Line Item Scope of Work Bid Subtotal**
BB1	Contractors' Cost of Work	Words: _____Dollars Figures: ($_____)

BB2	**Unit Price No.**	**Contractor's Unit Price Bid**	**Bid Quantity**	**Unit Price Allowance (UPA) Amount** ***(To be included in Base Bid)***
	Unit Price No. 1 – One-half inch (½") Domestic Water Pipe: Provide and install one linear foot of additional 1/2" Domestic Water Pipe installed including insulation and hangers. Perform in accordance with applicable Division 22 Sections and drawing requirements for similar work.	$_____/ LF	50 LF	**Unit Price Allowance No. UPA-1** **$**_____
	Unit Price No. 2 – One-half inch (½") Ball Valves: One unit is defined as: Provide and install one additional 1/2" ball valve installed in accordance with applicable Division 22 Sections and drawing requirements for similar work.	$_____/ASSEMBLY	5 ASSEMBLIES	**Unit Price Allowance No. UPA-2** **$**_____
	Unit Price No. 3 – Four inch (4") Sanitary Pipe: One unit is defined as: Provide and install one linear foot of additional 4" sanitary pipe installed including excavation and backfill installed in accordance with applicable Division 22 Sections and drawing requirements for similar work.	$_____/ LF	50 LF	**Unit Price Allowance No. UPA-3** **$**_____
	Unit Price No. 4 – Four-inch (4") Storm and Overflow Pipe: One unit is defined as: Provide and install one linear foot of additional 4" storm pipe installed including excavation and backfill installed in accordance with applicable Division 22 Sections and	$_____/ LF	20 LF	**Unit Price Allowance No. UPA-4** **$**_____

	drawing requirements for similar work.			
	Unit Price No. 5 – Sprinkler Pipe, incl. hangers and insulation: One unit is defined as one linear foot of the following scope of work: Provide and install sprinkler pipe including hangers and insulation in accordance with applicable Division 22 Sections and drawing requirements for similar work.	$_____/ LF	30 LF	**Unit Price Allowance No. UPA-5** **$**_____
	Unit Price No. 6 – Sprinkler Head & Flex-Pipe Connection: In accordance with applicable Division 22 Sections and drawing requirements for similar work, provide and install new concealed sprinkler head in finished ceiling areas with up to 20' of piping at each location including hangers, armover or flexible drop, and accessories.	$_____/ ASSEMBLY	5 ASSEMBLIES	**Unit Price Allowance No. UPA-6** **$**_____
	Unit Price No. 7 – Radon Piping: One unit is defined as provide and install one linear foot of piping, including removal of existing radon piping, capping, and and replacement/ tie-in of new radon piping, in accordance with applicable Division 22 Sections and drawing requirements for similar work.	$_____/ LF	20 LF	**Unit Price Allowance No. UPA-7** **$**_____
	Unit Price No. 8 – One and one-half inch (1-1/2") Type L Copper Piping: One unit is defined as: Remove and replace one linear foot of 1-1/2" Type L copper piping in kind, including hangers and insulation, in accordance with applicable Division 22 Sections and drawing requirements for similar work. .	$_____/ LF	50 LF	**Unit Price Allowance No. UPA-8** **$**_____
	Unit Price No. 9 – Two inch (2") Domestic Cold Water Piping: One unit is defined as one linear foot of the following: Provide and install 2" domestic cold water piping			

	incl. hangers & insulation, in accordance with applicable Division 22 Sections and drawing requirements for similar work.	$_____/ LF	20 LF	**Unit Price Allowance No. UPA-9** **$**_____
	Unit Price No. 10 – One and one-half inch (1- 1/2") Vent Piping: One unit is defined as one linear foot of the following: Provide and install 1 1/2" vent piping, in accordance with applicable Division 22 Sections and drawing requirements for similar work.	$_____/ LF	50 LF	**Unit Price Allowance No. UPA-10** **$**_____
	Unit Price No. 11 – Two inch (2") Schedule 40 Black Steel Piping: One unit is defined as one linear foot of the following: Provide and install 2" schedule 40 black steel piping including hangers and supports, in accordance with applicable Division 22 Sections and drawing requirements for similar work.	$_____/ LF	20 LF	**Unit Price Allowance No. UPA-11** **$**_____
	Unit Price No. 12 – Cast-Iron Piping: One unit is defined as one linear foot of the following: Cut existing floor, remove existing underslab pipe, replace with up to 4" Ø new cast iron pipe, backfill with 2A modified stone, install vapor barrier and concrete floor slab to the appropriate elevation and ready to receive floor finish material, in accordance with applicable Division 22 Sections and drawing requirements for similar work.	$_____/ LF	25 LF	**Unit Price Allowance No. UPA-12** **$**_____
	Unit Price No. 13 – Four-inch (4") Floor Cleanouts: One unit is defined as one assembly consisting of the following: Provide and install 4" floor cleanout in existing floor, to include cutting and patching of existing floor, in accordance with applicable Division 22 Sections and drawing requirements for similar work.	$_____/ ASSEMBLY	2 ASSEMBLIES	**Unit Price Allowance No. UPA-13** **$**_____

	Unit Price No. 14 – Fyrewrap Pipe Insulation: One unit is defined as one linear foot of the following scope of work: Provide and install UL Listed Fyrewrap insulation on existing PVC piping within new plenum spaces, in accordance with applicable Division 22 Sections and drawing requirements for similar work.	$_____/ LF	25 LF	**Unit Price Allowance No. UPA-14** **$**_____
	Unit Price No. 15 – One inch (1") Condensate Piping: Comply with requirements for Division 23 Sections. One unit is defined as one linear foot of the following: Furnish and install condensate piping, including all elements necessary to provide a complete and functional installation.	$_____/ LF	50 LF	**Unit Price Allowance No. UPA-15** **$**_____

TOTAL LUMP SUM BASE BID Contractors' Cost for the Work (**BB1**) + Unit Price Allowances (**BB2**)
Words:_____Dollars
Figures: ($_____)

Accompanying this Proposal is a certified check, bank cashier's check, bank treasurer's check or Bid Bond required by the Checklist and Instructions to Bidders, in the amount of 10% of the total Base Bid plus ALL possible ADD Alternates, which is deposited as a proposal guarantee, and is to be retained by you and applied as provided in the Instruction to Bidders, in case the undersigned shall default in executing the Contract or in furnishing the required Bonds and insurance certificates within the time specified by the Contract Documents.

The undersigned hereby certifies that this Proposal is genuine and not sham or collusive or made in the interest of or in behalf of any person, firm or corporation not herein named and that the undersigned has not directly or indirectly induced or solicited any bidder to refrain from bidding and that the undersigned has not in any manner sought by collusion to secure for himself any advantages over any other bidder.

The undersigned, intending to be legally bound, agrees that this Proposal shall be irrevocable and shall remain subject to your acceptance for 90 days after date set for bid opening unless the Owner is delayed in awarding the Contract due to the failure to receive a required approval or permit from one or more reviewing bodies/governmental agencies having jurisdiction over the Project, the sale of bonds, or the award of a grant, in which case, Bids shall remain open for 120 days after the day of Bid Opening. BIDDER will sign the Agreement and submit the Contract Security and other documents required by the Contract Documents within ten (10) days after the date of OWNER'S Notice of Award, except as provided by Act 317 of 1978, approved November 26, 1978, which provides for possible extensions of the holding period.

The undersigned submit this Proposal with the full knowledge of the Contract Document and Project requirements and hereby agrees that each phase of the work of this Project, under this Contract, shall be fully and finally completed and ready for occupancy and use on or before the completion date identified for that specific phase in the Contract Documents.

Bidder accepts the provisions of the Agreement as to the liquidated damages for failure to meet the milestone dates defined and substantial completion of the project shall be calculated at One Thousand Dollars ($1,000.00) per day for each calendar day of delay until the work is substantially complete.

The contract amount stated above includes all sales taxes, excise, and other taxes for all materials and appliances subject to and upon which taxes are levied.

The undersigned must enclose the following required attachments to this Bid Form. **Each bidder shall submit one (1) hard copy of the complete bid submission.**

The following shall be included in the bid submission:

1. Form of Proposal, fully executed and notarized
2. Bid Bond or Certified Check or Cashier's check in the amount of 10% of the Bid total and shall include Consent of Surety and Power of Attorney
3. Non-Collusion Affidavit, Signed and Sealed
4. Non-Discrimination Clause, Signed and Sealed
5. PA Public Works Employment Verification Form (E-Verify)

Note that the following will be required to be submitted by ALL Bidders at the request of the Construction Manager within 48 hours of bid submission:

1. Bidder's Qualifications, AIA A305, completed
2. Schedule of Values
3. List of Subcontractors
4. Safety Questionnaire

Note that the successful bidder will be required to submit the following documents and any other documents deemed necessary by the Construction Manager upon issuance of Letter of Intent to Award:

1. Certificate of Insurance
2. Performance Bond in the amount of 100%
3. Payment Bond in the amount of 100%
4. No Lien Agreement
5. Maintenance Bond

The undersigned shall indemnify and hold harmless Council Rock School District, Boyle Construction, Inc., and Marotta / Main Architects, all consultants and each officer and employees, with respect to any claims, losses, expenses, costs and reasonable attorney's fees incurred by Council Rock School District, Boyle Construction, Inc., Marotta / Main Architects, all consultants and each officer and employees, with regard to the undersigned's failure to comply with these Bid Documents and procedures.

Permits and Inspections: Any required permit fee will be paid by the Owner. Upon award, the successful prime contractor must complete any applicable permit form (and business licenses if required) and submit to the Borough. Inspection fees will be paid for by the Owner. Any additional costs incurred due to failed inspections shall be paid by the prime contractor. Any required contractor or business license fees required by the Borough are to be paid by the prime contractor.

The Owner also reserves the right to solicit independent proposals as required by Council Rock School District guidelines, under a separate contract to perform the services required. **The responsiveness of the Bid and if the Bid is responsible, may be determined by the Owner on the basis of the Unit Prices proposed by the bidder. Unit Prices shall be consistent with verifiable average costs for the work to be performed. Bidders agree that a proposal may be rejected if the Unit Prices submitted are inconsistent with the average cost.** Under NO circumstances will BIDDER perform Unit Price Work without prior written authorization from the OWNER. Contract Unit Price shall include costs for furnishing and installing all materials, labor, tools, equipment, and other incidentals necessary to complete the specified operation. Contract Unit Price shall also apply to deletion of "furnishing and installing" items from the Project.

In submitting this Bid, it is understood that the OWNER reserves the unrestricted right to reject any and all bids, or to waive any informalities or technicalities in said Bids.

UNIT PRICE ALLOWANCES: The Contractor must provide a change in scope of work (no change in Contract Sum or Contract Time) Change Order for the allowance work, indicating the allowance amount to be utilized, in which the Construction Manager (CMa) must review with the Owner and approve prior to the Contractor performing the Work. Should the allowance amount be exceeded and the Work approved to be performed, the Contractor will provide a Change Order for the additional Work and only be paid by an approved Change Order for the additional related Work. Similarly, should the allowance used be less than the allowance amount, the Contractor will credit the Owner for the unused allowance

amount by a Change Order credit. All OH&P for allowances MUST be included within the Base Bid of the Project. NO additional OH&P will be allowed in allowances. Change Orders for the utilization of allowances shall not include OH&P. Change Orders for additional Work exceeding allowance amounts shall include OH&P. Change Orders for credit of unused allowance amounts shall be provided with OH&P in addition to the remaining allowance amount. OH&P for all stipulations noted above is to be a maximum of 5% combined.

ALTERNATES: The Bidder agrees that the Owner shall have the right to accept or reject any or all of the following alternates, which acceptance or rejection shall enter into the determination of the lowest Bidder. The Bidder agrees that the Contract Time shall not be increased on account of the acceptance of any one or combination of alternates unless specifically stated in such alternate description(s). The Bidder agrees that the Owner shall have the right to accept an alternate that is higher in price than the Base Bid or other alternate. Alternates' prices shall include the cost of furnishing and installing all materials, labor, tools, equipment and other incidentals necessary to complete the Work in accordance with the design intent, manufacturers' recommendations, building codes, authorities having jurisdiction, and the Construction Documents. Do not adjust material allowances under any alternate bid items. Indicate whether alternate cost is an Add or Deduct when a choice is provided. If there is no change in the contract amount for any alternate write "NO CHANGE" or "Zero (0)" in the blank. The failure to enter an amount or "NO CHANGE" in the blanks for an alternate shall be treated conclusively as a Bid of zero dollars for the work described in the alternate.

Alternate #1: The Bidder shall state the adjustment in price to be added to or deducted from the Base Bid to increase the Contractor's Warranty period from one-year to two-year from the date of substantial completion (excluding landscaping). This alternate does not affect other warranties required by the Contract Documents or provided by manufacturers.

ADD/DEDUCT_____Dollars.
(Words)

($ _____)
(Figures)

The undersigned hereby acknowledge receipt of following Addenda and has prepared this bid accordingly:

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

SIGNATURES:

In witness whereof, the undersigned has caused this Proposal to be executed this _____ day of _____, 20_____.

INDIVIDUAL, PARTNERSHIP, LLC OR CORPORATION

_____
(Firm Name)

By: _____
(Signature)

_____
(Print Name and Title of Authorized Person to Sign)

State of Incorporation: _____

Business Address: _____

_____

_____

Telephone Number: _____

Email Address: _____

_____
Attest By

_____
Print Name of Person

Business/Corporate Seal:

Council Rock School District
Chancellor Center Renovations
30 North Chancellor Street
Newtown, PA 18940

Bid Form
Bid Package #03 – Mechanical Construction

Bids Due : 11/17/26 @ 2:00 PM

Deliver Sealed bids to:
Council Rock School District
Attn: Jessica Weiss, Purchasing Secretary
Chancellor Center
30 North Chancellor Street
Newtown, PA 18940

Date: _____

Firm Name: _____

Firm Address: _____

_____

Contact: _____

Phone Number: _____

Email: _____

THIS BID FORM SHALL NOT BE ALTERED IN ANY MANNER. ANY ALTERED BID FORMS SHALL BE CONSIDERED NON-RESPONSIVE AND WILL BE REJECTED.

This Bid is submitted in accordance with your Advertisement inviting bids to be received for the Council Rock School District Chancellor Center Renovations Bid Package #03 Mechanical Construction.

The undersigned BIDDER proposes and agrees, if this Bid is accepted, to enter into an Agreement with OWNER in the form included in the Contract Documents to complete all Work as specified or indicated in the Contract Documents for the Contract Price and within the Contract Time indicated in this Bid and in accordance with the Contract Documents.

In submitting this Bid, BIDDER represents, as more fully set forth in the agreement that:

a. BIDDER has carefully examined the Contract Documents including all Addenda which are incorporated with these documents indicating various conditions affecting this contract, the undersigned herein agrees to furnish all materials, perform all labor and do all else necessary to complete the work for the Bid Package #03 indicated above for the Contract for the above named Project in accordance with said Contract Documents.

b. BIDDER has examined the site and locality where the Work is to be performed, the legal requirements (federal, state, and local laws, ordinances, rules and regulations) and the conditions affecting cost, progress or performance of the Work and has made such independent investigations as BIDDER deems necessary. Failure to visit and not be familiar with the Project site shall be no reason for future requests for additional compensation or costs of any kind.

LUMP SUM BASE BID – The contractor shall state the price for the completion of all work as indicated by the Contract Documents that is not included in the bid alternates listed below. This price shall be the base bid. **The base bid below shall include any and all allowances as described below**. All allowances MUST include all overhead and profit.

	BASE BID LINE ITEM SUB-TOTALS	
	Line Item Scope of Work	**Line Item Scope of Work Bid Subtotal**
BB1	Contractors' Cost of Work	Words: _____Dollars Figures: ($_____)

BB2	**Unit Price No.**	**Contractor's Unit Price Bid**	**Bid Quantity**		**Unit Price Allowance (UPA) Amount** ***(To be included in Base Bid)***
	Unit Price No. 1 – One inch (1") Condensate Piping: Comply with requirements for Division 23 Sections. One unit is defined as one linear foot of the following: Furnish and install condensate piping, including all elements necessary to provide a complete and functional installation.	$_____/ LF	200 LF		**Unit Price Allowance No. UPA-1** **$**_____
	Unit Price No. 2 – Two inch (2") Ball Valve: One unit is defined as furnish and install one 2" ball valve according to Division 23 Sections.	$_____/ UNIT	10 UNITS		**Unit Price Allowance No. UPA-2** **$**_____
	Unit Price No. 3 – Insulated galvanized steel ductwork: One unit is defined as furnish and install one pound of insulated galvanized steel ductwork, including insulation, according to Div. 23 Sections.	$_____/ LB	200 LBS		**Unit Price Allowance No. UPA-3** **$**_____
	Unit Price No. 4 – DDC Damper Actuator: One unit is defined as providing, installing, and wiring one DDC damper actuator according to Division 23 Sections.	$_____/ UNIT	5 UNITS		**Unit Price Allowance No. UPA-4** **$**_____
	Unit Price No. 5 – Carbon Monoxide Sensor: One unit is defined as providing, installing, wiring, and programming one carbon monoxide sensor				

	according to Division 23 Sections.	$_____/ UNIT	5 UNITS		**Unit Price Allowance No. UPA-5** **$**_____
	Unit Price No. 6 – Combination Temperature/ Humidity Sensor: One unit is defined as providing, installing, wiring, and programming one combination temperature/ humidity sensor according to Division 23 Sections.	$_____/ UNIT	5 UNITS		**Unit Price Allowance No. UPA-6** **$**_____
	Unit Price No. 7 – Insulated Refrigerant HVAC Piping (New): One unit is defined as one linear foot of NEW insulated refrigerant HVAC piping assembly. The NEW insulated refrigerant HVAC piping assembly consists of: insulated refrigerant piping, accessories, and fittings. Comply with requirements for Division 23 Sections.	$_____/ LF	200 LF		**Unit Price Allowance No. UPA-7** **$**_____
	Unit Price No. 8 – Duct Insulation: One unit is defined as one square foot of fiberglass duct insulation, including furnishing and installing fiberglass duct insulation, including jacket, adhesives, fasteners, taping, sealing, cutting, fitting, labor, materials, equipment, overhead, and profit, in accordance with Division 23 Sections.	$_____/ SF	300 SF		**Unit Price Allowance No. UPA-8** **$**_____
	Unit Price No. 9 – Rated Access Door: Units are measured as "each unit". One unit is defined as providing and installing one wall or ceiling 1-hour fire-rated access door, 2' x 2' size.	$_____/ UNIT	2 UNITS		**Unit Price Allowance No. UPA-9** **$**_____
	Unit Price No. 10 – HVAC Piping (Remove existing 2-inch insulated): Comply with requirements for Division 23 Sections. One unit is defined as one linear foot of existing 2" insulated HVAC piping assembly to be removed, including accessories.	$_____/ LF	50 LF		**Unit Price Allowance No. UPA-10** **$**_____

	Unit Price No. 11 – Journeyman Sheet Metal Worker: One unit is defined as 1 hour of labor. Provide a journeyman sheet metal worker at the following fully burdened rate.	$_____/ HR	60 HRS		**Unit Price Allowance No. UPA-11** **$**_____
	Unit Price No. 12 – Journeyman Steamfitter (Pipefitter): One unit is defined as 1 hour of labor. Provide a journeyman steamfitter (pipefitter) at the following fully burdened rate.	$_____/ HR	60 HRS		**Unit Price Allowance No. UPA-12** **$**_____

TOTAL LUMP SUM BASE BID Contractors' Cost for the Work (**BB1**) + Unit Price Allowances (**BB2**)
Words:_____Dollars
Figures: ($_____)

Accompanying this Proposal is a certified check, bank cashier's check, bank treasurer's check or Bid Bond required by the Checklist and Instructions to Bidders, in the amount of 10% of the total Base Bid plus ALL possible ADD Alternates, which is deposited as a proposal guarantee, and is to be retained by you and applied as provided in the Instruction to Bidders, in case the undersigned shall default in executing the Contract or in furnishing the required Bonds and insurance certificates within the time specified by the Contract Documents.

The undersigned hereby certifies that this Proposal is genuine and not sham or collusive or made in the interest of or in behalf of any person, firm or corporation not herein named and that the undersigned has not directly or indirectly induced or solicited any bidder to refrain from bidding and that the undersigned has not in any manner sought by collusion to secure for himself any advantages over any other bidder.

The undersigned, intending to be legally bound, agrees that this Proposal shall be irrevocable and shall remain subject to your acceptance for 90 days after date set for bid opening unless the Owner is delayed in awarding the Contract due to the failure to receive a required approval or permit from one or more reviewing bodies/governmental agencies having jurisdiction over the Project, the sale of bonds, or the award of a grant, in which case, Bids shall remain open for 120 days after the day of Bid Opening. BIDDER will sign the Agreement and submit the Contract Security and other documents required by the Contract Documents within ten (10) days after the date of OWNER'S Notice of Award, except as provided by Act 317 of 1978, approved November 26, 1978, which provides for possible extensions of the holding period.

The undersigned submit this Proposal with the full knowledge of the Contract Document and Project requirements and hereby agrees that each phase of the work of this Project, under this Contract, shall be fully and finally completed and ready for occupancy and use on or before the completion date identified for that specific phase in the Contract Documents.

Bidder accepts the provisions of the Agreement as to the liquidated damages for failure to meet the milestone dates defined and substantial completion of the project shall be calculated at One Thousand Dollars ($1,000.00) per day for each calendar day of delay until the work is substantially complete.

The contract amount stated above includes all sales taxes, excise, and other taxes for all materials and appliances subject to and upon which taxes are levied.
The undersigned must enclose the following required attachments to this Bid Form. **Each bidder shall submit one (1) hard copy of the complete bid submission.**

The following shall be included in the bid submission:

1. Form of Proposal, fully executed and notarized
2. Bid Bond or Certified Check or Cashier's check in the amount of 10% of the Bid total and shall include Consent of Surety and Power of Attorney
3. Non-Collusion Affidavit, Signed and Sealed
4. Non-Discrimination Clause, Signed and Sealed
5. PA Public Works Employment Verification Form (E-Verify)

Note that the following will be required to be submitted by ALL Bidders at the request of the Construction Manager within 48 hours of bid submission:

1. Bidder's Qualifications, AIA A305, completed
2. Schedule of Values
3. List of Subcontractors
4. Safety Questionnaire

Note that the successful bidder will be required to submit the following documents and any other documents deemed necessary by the Construction Manager upon issuance of Letter of Intent to Award:

1. Certificate of Insurance
2. Performance Bond in the amount of 100%
3. Payment Bond in the amount of 100%
4. No Lien Agreement
5. Maintenance Bond

The undersigned shall indemnify and hold harmless Council Rock School District, Boyle Construction, Inc., and Marotta / Main Architects, all consultants and each officer and employees, with respect to any claims, losses, expenses, costs and reasonable attorney's fees incurred by Council Rock School District, Boyle Construction, Inc., Marotta / Main Architects, all consultants and each officer and employees, with regard to the undersigned's failure to comply with these Bid Documents and procedures.

Permits and Inspections: Any required permit fee will be paid by the Owner. Upon award, the successful prime contractor must complete any applicable permit form (and business licenses if required) and submit to the Borough. Inspection fees will be paid for by the Owner. Any additional costs incurred due to failed inspections shall be paid by the prime contractor. Any required contractor or business license fees required by the Borough are to be paid by the prime contractor.

The Owner also reserves the right to solicit independent proposals as required by Council Rock School District guidelines, under a separate contract to perform the services required. **The responsiveness of the Bid and if the Bid is responsible, may be determined by the Owner on the basis of the Unit Prices proposed by the bidder. Unit Prices shall be consistent with verifiable average costs for the work to be performed. Bidders agree that a proposal may be rejected if the Unit Prices submitted are inconsistent with the average cost.** Under NO circumstances will BIDDER perform Unit Price Work without prior written authorization from the OWNER. Contract Unit Price shall include costs for furnishing and installing all materials, labor, tools, equipment, and other incidentals necessary to complete the specified operation. Contract Unit Price shall also apply to deletion of "furnishing and installing" items from the Project.

In submitting this Bid, it is understood that the OWNER reserves the unrestricted right to reject any and all bids, or to waive any informalities or technicalities in said Bids.

UNIT PRICE ALLOWANCES: The Contractor must provide a change in scope of work (no change in Contract Sum or Contract Time) Change Order for the allowance work, indicating the allowance amount to be utilized, in which the Construction Manager (CMa) must review with the Owner and approve prior to the Contractor performing the Work. Should the allowance amount be exceeded and the Work approved to be performed, the Contractor will provide a Change Order for the additional Work and only be paid by an approved Change Order for the additional related Work. Similarly, should the allowance used be less than the allowance amount, the Contractor will credit the Owner for the unused allowance amount by a Change Order credit. All OH&P for allowances MUST be included within the Base Bid of the Project. NO additional OH&P will be allowed in allowances. Change Orders for the utilization of allowances shall not include OH&P. Change Orders for additional Work exceeding allowance amounts shall include OH&P. Change Orders for credit of unused allowance amounts shall be provided with OH&P in addition to the remaining allowance amount. OH&P for all stipulations noted above is to be a maximum of 5% combined.

ALTERNATES: The Bidder agrees that the Owner shall have the right to accept or reject any or all of the following alternates, which acceptance or rejection shall enter into the determination of the lowest Bidder. The Bidder agrees that the Contract Time shall not be increased on account of the acceptance of any one or combination of alternates unless specifically stated in such alternate description(s). The Bidder agrees that the Owner shall have the right to accept an alternate that is higher in price than the Base Bid or other alternate. Alternates' prices shall include the cost of furnishing and installing all materials, labor, tools, equipment and other incidentals necessary to complete the Work in accordance with the design intent, manufacturers' recommendations, building codes, authorities having jurisdiction, and the Construction Documents. Do not adjust material allowances under any alternate bid items. Indicate whether alternate cost is an Add or Deduct when a choice is provided. If there is no change in the contract amount for any alternate write "NO CHANGE" or "Zero (0)" in the blank. The failure to enter an amount or "NO CHANGE" in the blanks for an alternate shall be treated conclusively as a Bid of zero dollars for the work described in the alternate.

Alternate #1: The Bidder shall state the adjustment in price to be added to or deducted from the Base Bid to increase the Contractor's Warranty period from one-year to two-year from the date of substantial completion (excluding landscaping). This alternate does not affect other warranties required by the Contract Documents or provided by manufacturers.

ADD/DEDUCT_____Dollars.
(Words)

($ _____)
(Figures)

The undersigned hereby acknowledge receipt of following Addenda and has prepared this bid accordingly:

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

SIGNATURES:

In witness whereof, the undersigned has caused this Proposal to be executed this _____ day of _____, 20_____.

INDIVIDUAL, PARTNERSHIP, LLC OR CORPORATION

_____
(Firm Name)

By: _____
(Signature)

_____
(Print Name and Title of Authorized Person to Sign)

State of Incorporation: _____

Business Address: _____

_____

_____

Telephone Number: _____

Email Address: _____

_____
Attest By

_____
Print Name of Person

Business/Corporate Seal:

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Council Rock School District
Chancellor Center Renovations
30 North Chancellor Street
Newtown, PA 18940

Bid Form
Bid Package #04 – Electrical Construction

Bids Due: 11/17/26 @ 2:00 PM

Deliver Sealed bids to:
Council Rock School District
Attn: Jessica Weiss, Purchasing Secretary
Chancellor Center
30 North Chancellor Street
Newtown, PA 18940

Date: _____

Firm Name: _____

Firm Address: _____

_____

Contact: _____

Phone Number: _____

Email: _____

THIS BID FORM SHALL NOT BE ALTERED IN ANY MANNER. ANY ALTERED BID FORMS SHALL BE CONSIDERED NON-RESPONSIVE AND WILL BE REJECTED.

This Bid is submitted in accordance with your Advertisement inviting bids to be received for the Council Rock School District Chancellor Center Renovations Bid Package #04 Electrical Construction.

The undersigned BIDDER proposes and agrees, if this Bid is accepted, to enter into an Agreement with OWNER in the form included in the Contract Documents to complete all Work as specified or indicated in the Contract Documents for the Contract Price and within the Contract Time indicated in this Bid and in accordance with the Contract Documents.

In submitting this Bid, BIDDER represents, as more fully set forth in the agreement that:

a. BIDDER has carefully examined the Contract Documents including all Addenda which are incorporated with these documents indicating various conditions affecting this contract, the undersigned herein agrees to furnish all materials, perform all labor and do all else necessary to complete the work for the Bid Package #04 indicated above for the Contract for the above named Project in accordance with said Contract Documents.

b. BIDDER has examined the site and locality where the Work is to be performed, the legal requirements (federal, state, and local laws, ordinances, rules and regulations) and the conditions affecting cost, progress or performance of the Work and has made such independent investigations as BIDDER deems necessary. Failure to visit and not be familiar with the Project site shall be no reason for future requests for additional compensation or costs of any kind.

<u>LUMP SUM BASE BID –</u> The contractor shall state the price for the completion of all work as indicated by the Contract Documents that is not included in the bid alternates listed below. This price shall be the base bid. **The base bid below shall include any and all allowances as described below**. All allowances MUST include all overhead and profit.

	BASE BID LINE ITEM SUB-TOTALS	
	Line Item Scope of Work	**Line Item Scope of Work Bid Subtotal**
BB1	Contractors' Cost of Work	Words: _____Dollars Figures: ($_____)

BB2	**Unit Price No.**	**Contractor's Unit Price Bid**	**Bid Quantity**	**Unit Price Allowance (UPA) Amount** ***(To be included in Base Bid)***
	Unit Price No. 1 – Duplex Receptacle & Wiring: Provide and install one additional duplex receptacle assembly and 20A circuit. Include 20A, 120V duplex receptacle, backbox, cover plate, ¾" conduit/raceway with 2 #12 conductors and 1 #12 ground wire to a point of authorized connection, necessary wall penetration cutting and patching, terminations and labeling. Max. Dist. 75'.	$_____/ ASSEMBLY	5 ASSEMBLIES	**Unit Price Allowance No. UPA-1** **$**_____
	Unit Price No. 2 – Exit Sign & Wiring: Provide and install one additional exit sign assembly (luminaire type EX1) including appropriate mounting equipment, ¾" conduit/raceway with 2#10 conductors and 1 #12 ground wire, necessary wall penetration, cutting and patching, terminations and connections. Connect to unswitched hot leg of branch circuit serving associated room "normal" lighting. Max. Dist. 50'.	$_____/ ASSEMBLY	4 ASSEMBLIES	**Unit Price Allowance No. UPA-2** **$**_____
	Unit Price No. 3 – Exit Sign & Wiring: Provide and install one additional exit sign assembly (luminaire type EX1) including appropriate mounting equipment, ¾" conduit/raceway			

	with 2#10 conductors and 1 #12 ground wire, necessary wall penetration, cutting and patching, terminations and connections. Connect to unswitched hot leg of branch circuit serving associated room "normal" lighting. Max. Dist. 50'.	$_____/ ASSEMBLY	4 ASSEMBLIES	**Unit Price Allowance No. UPA-3** **$**_____
	Unit Price No. 4 – Exit Sign & Wiring: Provide and install one additional exit sign assembly (luminaire type EX1) including appropriate mounting equipment, ¾" conduit/raceway with 2#10 conductors and 1 #12 ground wire, necessary wall penetration, cutting and patching, terminations and connections. Connect to unswitched hot leg of branch circuit serving associated room "normal" lighting. Max. Dist. 50'.	$_____/ ASSEMBLY	2 ASSEMBLIES	**Unit Price Allowance No. UPA-4** **$**_____
	Unit Price No. 5 – Fire Alarm Pull Station & Wiring: Provide and install one additional pull station assembly, consisting of pull station device, backbox, cabling, conduit, necessary wall penetration cutting and patching, terminations, connections to fire alarm system, and programming required. Max. Dist. 100'.	$_____/ ASSEMBLY	2 ASSEMBLIES	**Unit Price Allowance No. UPA-5** **$**_____
	Unit Price No. 6 – Fire Alarm Audible/Visual Device & Wiring: Provide and install one additional fire alarm A/V device assembly, consisting of A/V device, backbox, cabling, conduit, necessary wall penetration cutting and patching, terminations, connections to fire alarm system, programming, and additional power supplies required. Max. Dist. 100'.	$_____/ ASSEMBLY	2 ASSEMBLIES	**Unit Price Allowance No. UPA-6** **$**_____
	Unit Price No. 7 – Fire Alarm Addressable Device & Wiring: Provide and install one additional fire alarm addressable device assembly,			

	consisting of addressable device, backbox, cabling, conduit, necessary wall penetration cutting and patching, terminations, connections to fire alarm system, programming, and additional power supplies required. Max. Dist. 100'.	$_____/ ASSEMBLY	2 ASSEMBLIES	**Unit Price Allowance No. UPA-7** **$**_____
	Unit Price No. 8 – C4 Data Outlets and Wiring: Provide and install one additional C4 data outlet as detailed on the Drawings consisting of backbox, jacks, plate, cabling, patch panel port, conduit, all terminations, labeling, testing and accessories; warranty shall be included on this outlet. Max. Dist. 300'.	$_____/ ASSEMBLY	2 ASSEMBLIES	**Unit Price Allowance No. UPA-8** **$**_____
	Unit Price No. 9 – Specialty low-voltage outlet: Video Surveillance / IP Speaker / Vape Sensor Outlet and Wiring: Provide and install one additional outlet (type as required for space) as detailed on the Drawings consisting of backbox, jacks, plate, cabling, conduit, all terminations and labeling; warranty shall be included on this outlet. Max. Dist. 300'.	$_____/ ASSEMBLY	2 ASSEMBLIES	**Unit Price Allowance No. UPA-9** **$**_____
	Unit Price No. 10 – 100A Fused Disconnect Switch and Wiring: Provide and install one additional 3P.100A fused disconnect switch assembly. Include 3P.100A circuit breaker to be installed in panelboard or switchboard, 3P.100A fused disconnect switch, (3) 100A fuses, 3#1 + 1#6 ground in 1-1/2" conduit to a point of authorized connection, necessary wall penetration cutting and patching, terminations and labeling. Max. Dist. 200'.	$_____/ ASSEMBLY	2 ASSEMBLIES	**Unit Price Allowance No. UPA-10** **$**_____
	Unit Price No. 11 – 60A Fused Disconnect Switch and Wiring: Provide and install one additional 3P.60A fused			

	disconnect switch assembly. Include 3P.60A circuit breaker to be installed in panelboard or switchboard, 3P.60A fused disconnect switch, (3) 60A fuses, 3#4 + 1#10 ground in 1-1/4" conduit to a point of authorized connection, necessary wall penetration cutting and patching, terminations and labeling. Max. Dist. 200'.	$_____/ ASSEMBLY	2 ASSEMBLIES	**Unit Price Allowance No. UPA-11** **$**_____
	Unit Price No. 12 – Conduit Relocation: Provide for relocation of conduit up to and including 1-1/4" trade size, containing sixteen #12 AWG conductors. Furnish and install 30 linear feet of conduit, plus (16) #12 AWG THHN conductors. Provide for disconnection of existing conduit, two junction boxes, disconnection, and reconnection of conductors after relocation.	$_____/ 30' LF	15 30' LF SECTIONS	**Unit Price Allowance No. UPA-12** **$**_____
	Unit Price No. 13 – Card Reader Assembly: Provide and install one additional card reader assembly consisting of backbox, mounting equipment, junction boxes, 150' of required low voltage cabling, 20' of conduit and all terminations and connections to the line voltage circuit, low voltage to door controller and door equipment, and programming.	$_____/ ASSEMBLY	8 ASSEMBLIES	**Unit Price Allowance No. UPA-13** **$**_____

TOTAL LUMP SUM BASE BID Contractors' Cost for the Work (**BB1**) + Unit Price Allowances (**BB2**)
Words:_____Dollars
Figures: ($_____)

Accompanying this Proposal is a certified check, bank cashier's check, bank treasurer's check or Bid Bond required by the Checklist and Instructions to Bidders, in the amount of 10% of the total Base Bid plus ALL possible ADD Alternates, which is deposited as a proposal guarantee, and is to be retained by you and applied as provided in the Instruction to Bidders, in case the undersigned shall default in executing the Contract or in furnishing the required Bonds and insurance certificates within the time specified by the Contract Documents.

The undersigned hereby certifies that this Proposal is genuine and not sham or collusive or made in the interest of or in behalf of any person, firm or corporation not herein named and that the undersigned has not directly or indirectly induced

or solicited any bidder to refrain from bidding and that the undersigned has not in any manner sought by collusion to secure for himself any advantages over any other bidder.

The undersigned, intending to be legally bound, agrees that this Proposal shall be irrevocable and shall remain subject to your acceptance for 90 days after date set for bid opening unless the Owner is delayed in awarding the Contract due to the failure to receive a required approval or permit from one or more reviewing bodies/governmental agencies having jurisdiction over the Project, the sale of bonds, or the award of a grant, in which case, Bids shall remain open for 120 days after the day of Bid Opening. BIDDER will sign the Agreement and submit the Contract Security and other documents required by the Contract Documents within ten (10) days after the date of OWNER'S Notice of Award, except as provided by Act 317 of 1978, approved November 26, 1978, which provides for possible extensions of the holding period.

The undersigned submit this Proposal with the full knowledge of the Contract Document and Project requirements and hereby agrees that each phase of the work of this Project, under this Contract, shall be fully and finally completed and ready for occupancy and use on or before the completion date identified for that specific phase in the Contract Documents.

Bidder accepts the provisions of the Agreement as to the liquidated damages for failure to meet the milestone dates defined and substantial completion of the project shall be calculated at One Thousand Dollars ($1,000.00) per day for each calendar day of delay until the work is substantially complete.

The contract amount stated above includes all sales taxes, excise, and other taxes for all materials and appliances subject to and upon which taxes are levied.

The undersigned must enclose the following required attachments to this Bid Form. **Each bidder shall submit one (1) hard copy of the complete bid submission.**

The following shall be included in the bid submission:

1. Form of Proposal, fully executed and notarized
2. Bid Bond or Certified Check or Cashier's check in the amount of 10% of the Bid total and shall include Consent of Surety and Power of Attorney
3. Non-Collusion Affidavit, Signed and Sealed
4. Non-Discrimination Clause, Signed and Sealed
5. PA Public Works Employment Verification Form (E-Verify)

Note that the following will be required to be submitted by ALL Bidders at the request of the Construction Manager within 48 hours of bid submission:

1. Bidder's Qualifications, AIA A305, completed
2. Schedule of Values
3. List of Subcontractors
4. Safety Questionnaire

Note that the successful bidder will be required to submit the following documents and any other documents deemed necessary by the Construction Manager upon issuance of Letter of Intent to Award:

1. Certificate of Insurance
2. Performance Bond in the amount of 100%
3. Payment Bond in the amount of 100%
4. No Lien Agreement
5. Maintenance Bond

The undersigned shall indemnify and hold harmless Council Rock School District, Boyle Construction, Inc., and Marotta / Main Architects, all consultants and each officer and employees, with respect to any claims, losses, expenses, costs and reasonable attorney's fees incurred by Council Rock School District, Boyle Construction, Inc., Marotta / Main Architects, all consultants and each officer and employees, with regard to the undersigned's failure to comply with these Bid Documents and procedures.

Permits and Inspections: Any required permit fee will be paid by the Owner. Upon award, the successful prime contractor must complete any applicable permit form (and business licenses if required) and submit to the Borough. Inspection fees will be paid for by the Owner. Any additional costs incurred due to failed inspections shall be paid by the prime contractor. Any required contractor or business license fees required by the Borough are to be paid by the prime contractor.

The Owner also reserves the right to solicit independent proposals as required by Council Rock School District guidelines, under a separate contract to perform the services required. **The responsiveness of the Bid and if the Bid is responsible, may be determined by the Owner on the basis of the Unit Prices proposed by the bidder. Unit Prices shall be consistent with verifiable average costs for the work to be performed. Bidders agree that a proposal may be rejected if the Unit Prices submitted are inconsistent with the average cost.** Under NO circumstances will BIDDER perform Unit Price Work without prior written authorization from the OWNER. Contract Unit Price shall include costs for furnishing and installing all materials, labor, tools, equipment, and other incidentals necessary to complete the specified operation. Contract Unit Price shall also apply to deletion of "furnishing and installing" items from the Project.

In submitting this Bid, it is understood that the OWNER reserves the unrestricted right to reject any and all bids, or to waive any informalities or technicalities in said Bids.

UNIT PRICE ALLOWANCES: The Contractor must provide a change in scope of work (no change in Contract Sum or Contract Time) Change Order for the allowance work, indicating the allowance amount to be utilized, in which the Construction Manager (CMa) must review with the Owner and approve prior to the Contractor performing the Work. Should the allowance amount be exceeded and the Work approved to be performed, the Contractor will provide a Change Order for the additional Work and only be paid by an approved Change Order for the additional related Work. Similarly, should the allowance used be less than the allowance amount, the Contractor will credit the Owner for the unused allowance amount by a Change Order credit. All OH&P for allowances MUST be included within the Base Bid of the Project. NO additional OH&P will be allowed in allowances. Change Orders for the utilization of allowances shall not include OH&P. Change Orders for additional Work exceeding allowance amounts shall include OH&P. Change Orders for credit of unused allowance amounts shall be provided with OH&P in addition to the remaining allowance amount. OH&P for all stipulations noted above is to be a maximum of 5% combined.

ALTERNATES: The Bidder agrees that the Owner shall have the right to accept or reject any or all of the following alternates, which acceptance or rejection shall enter into the determination of the lowest Bidder. The Bidder agrees that the Contract Time shall not be increased on account of the acceptance of any one or combination of alternates unless specifically stated in such alternate description(s). The Bidder agrees that the Owner shall have the right to accept an alternate that is higher in price than the Base Bid or other alternate. Alternates' prices shall include the cost of furnishing and installing all materials, labor, tools, equipment and other incidentals necessary to complete the Work in accordance with the design intent, manufacturers' recommendations, building codes, authorities having jurisdiction, and the Construction Documents. Do not adjust material allowances under any alternate bid items. Indicate whether alternate cost is an Add or Deduct when a choice is provided. If there is no change in the contract amount for any alternate write "NO CHANGE" or "Zero (0)" in the blank. The failure to enter an amount or "NO CHANGE" in the blanks for an alternate shall be treated conclusively as a Bid of zero dollars for the work described in the alternate.

Alternate #1: The Bidder shall state the adjustment in price to be added to or deducted from the Base Bid to increase the Contractor's Warranty period from one-year to two-year from the date of substantial completion (excluding landscaping). This alternate does not affect other warranties required by the Contract Documents or provided by manufacturers.

ADD/DEDUCT_____Dollars.
(Words)

($ _____)
(Figures)

The undersigned hereby acknowledge receipt of following Addenda and has prepared this bid accordingly:

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

ADDENDUM #_____ Dated_____

SIGNATURES:

In witness whereof, the undersigned has caused this Proposal to be executed this _____ day of _____, 20_____.

INDIVIDUAL, PARTNERSHIP, LLC OR CORPORATION

_____
(Firm Name)

By: _____
(Signature)

_____
(Print Name and Title of Authorized Person to Sign)

State of Incorporation: _____

Business Address: _____

_____

_____

Telephone Number: _____

Email Address: _____

_____
Attest By

_____
Print Name of Person

Business/Corporate Seal:

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SECTION 00 13 00 - BID SECURITY FORM

The Bid Security Form utilized for this project shall be a “Bid Bond”, AIA Document A310-2010, included herein, or an approved equal. Reference Section 00 1100, “Instructions to Bidders” for the execution of the Bid Bond.

END OF SECTION 00 13 00

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AIA® Document A310™ – 2010

Bid Bond

CONTRACTOR:
(Name, legal status and address)
« »« »
« »

SURETY:
(Name, legal status and principal place of business)
« »« »
« »

OWNER:
(Name, legal status and address)
«Council Rock School District»
«30 North Chancellor Street
Newtown, PA 18940»

BOND AMOUNT: $ « »

PROJECT:
(Name, location or address, and Project number, if any)
«Chancellor Center Renovations»
«30 North Chancellor Street»
«Newtown, PA 18940»

The Contractor and Surety are bound to the Owner in the amount set forth above, for the payment of which the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, as provided herein. The conditions of this Bond are such that if the Owner accepts the bid of the Contractor within the time specified in the bid documents, or within such time period as may be agreed to by the Owner and Contractor, and the Contractor either (1) enters into a contract with the Owner in accordance with the terms of such bid, and gives such bond or bonds as may be specified in the bidding or Contract Documents, with a surety admitted in the jurisdiction of the Project and otherwise acceptable to the Owner, for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof; or (2) pays to the Owner the difference, not to exceed the amount of this Bond, between the amount specified in said bid and such larger amount for which the Owner may in good faith contract with another party to perform the work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect. The Surety hereby waives any notice of an agreement between the Owner and Contractor to extend the time in which the Owner may accept the bid. Waiver of notice by the Surety shall not apply to any extension exceeding sixty (60) days in the aggregate beyond the time for acceptance of bids specified in the bid documents, and the Owner and Contractor shall obtain the Surety's consent for an extension beyond sixty (60) days.

If this Bond is issued in connection with a subcontractor's bid to a Contractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

When this Bond has been furnished to comply with a statutory or other legal requirement in the location of the Project, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

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User Notes: (1280005747)

Signed and sealed this « » day of « » , « »

	« »
	(Contractor as Principal) *(Seal)*
	« »
(Witness)	*(Title)*
	« »
	(Surety) *(Seal)*
	« »
(Witness)	*(Title)*

DRAFT

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User Notes: (1280005747)

SECTION 00 13 10 – PROPOSAL CHECKLIST

The following represents a list of those Documents and materials, which will be required in connection with the Project. **Certain items will be required at time of the Bid submission; failure to submit them may result in disqualification of the Bid in accordance with Pennsylvania law; other items will be required after bid date but no later than time set for the Contract execution**. Specific review should be made of Bidding Documents contained in the Project Manual to ascertain what those Documents are and when they are required to be submitted.

Submissions required with the Bid:

[ ] Bid Form fully executed and notarized.

[ ] Bid Bond or Certified Check or Cashier's Check in the amount of 10% of the Bid total and shall include Consent of Surety and Power of Attorney, Signed and Sealed.

[ ] Non-Collusion Affidavit, Signed and Sealed

[ ] Non-Discrimination/Sexual Harassment Clause, Signed and Sealed

[ ] PA Public Works Employment Verification Form (E-Verify)

This checklist is submitted to the Bidders strictly as a courtesy and is not to be binding on the Owner. Responsibility for ascertaining and submitting the Documents needed for consideration of the Bid, and at appropriate time, falls upon each and every Bidder.

Submissions required after requested by the Construction Manager (within 48 hours of bid submission):

[ ] Bidder's Qualifications, AIA A305, completed.

[ ] A Schedule of Values.

[ ] List of Subcontractors.

[ ] Safety Questionnaire

Submissions required after Letter of Intent issued:

[ ] Certificate of Insurance.

[ ] Performance and Payment Bond (100%).

[ ] No Lien Agreement.

[ ] Maintenance Bond.

END OF SECTION 00 13 10

SECTION 00 14 00 - AGREEMENT OF SURETY

(Note: This Agreement must be properly executed and must accompany the Certified Check, or Bid Bond, whichever is furnished as Bid Security.)

KNOW ALL MEN BY THESE PRESENTS, that we, _____, as Surety, a corporation existing under the laws of the State of _____, and authorized to transact business in the Commonwealth of Pennsylvania hereby agrees intending to be legally bound hereby, to execute and deliver to the Council Rock School District, within the time limit specified in the Contract Documents, the Performance Bond and Payment Bond in the forms included in the Contract Documents each in an amount of 100% of the Contract Sum, in favor of the Council Rock School District, as required for the faithful performance and proper fulfillment of the contract for the Chancellor Center Renovations, 30 North Chancellor Street, Newtown, PA 18940, Bucks County, Newtown Borough, Pennsylvania, on behalf of _____ (hereinafter called the Bidder) provided that the above contract be awarded to the Bidder within ninety (90) days after the date of opening of the bids or otherwise as set forth in the Instructions to Bidders.

Surety further agrees that should the Surety, after notification of intent to make such award, omit or refuse to execute the required bonds and agreement, then the Surety shall pay to the Council Rock School District, hereinafter called the Obligee, any difference between the total amount specified in said Bidder's proposal for the required work and the amount of which said Obligee may procure the same work, if the latter amount be in excess of the former, plus any advertising, architectural, legal, and other expenses incurred by Obligee; provided, however, that the obligations of Surety hereunder shall not exceed the amount of bid security provided by the Bidder together with interest.

Dated: _____, 20__ _____
(CORPORATE SURETY)

WITNESS OR ATTEST:

_____ By: _____
Attorney-in-Fact*

NAME: _____
(Please type)

*Attach an appropriate Power of Attorney, dated as of the same date as this Agreement, evidencing the authority of the Attorney-in-Fact to act on behalf of the Corporation.

END OF SECTION 00 14 00

SECTION 00 15 00 - NON-COLLUSION AFFIDAVIT OF CONTRACTOR

State of _____

County of _____

I state that I am _____ of _____
(Title) (Entity Name)

and that I am authorized to make this affidavit on behalf of said entity.

I state that:

1. The price(s) and amount of this Bid have been arrived at independently and without consultation, communication, or agreement with any other contractor, bidder, or potential bidder.

2. Neither the price(s) nor the amount of this Bid, and neither the approximate price(s) nor approximate amount of this Bid, have been disclosed to any other firm or person who is a bidder or potential bidder, and they will not be disclosed before Bid opening.

3. No attempt has been made or will be made to induce any firm or person to refrain from bidding on this contract, or to submit a bid higher than this Bid, or to submit any intentionally high or noncompetitive bid or other form of complementary bid.

4. The Bid of my firm is made in good faith and not pursuant to any agreement or discussion with, or inducement from, any firm or person to submit a complementary or other noncompetitive bid.

5. _____,its affiliates,
(Entity)

   subsidiaries, officers, directors, and employees are not currently under investigation by any governmental agency and have not in the last three years been convicted or found liable for any act prohibited by State or Federal Law in any jurisdiction, involving conspiracy or collusion with respect to bidding on any public contract except as follows:

   _____

I state that, _____,
(Name of My Firm)

Council Rock School District in awarding the contract(s) for which this Bid is submitted. I understand, and my firm understands, that any misstatement in this Affidavit is and shall be treated as fraudulent concealment from the Council Rock School District of the true facts relating to the submission of bids for this contract.

_____
(Name)

_____
(Company, Firm Position)

SWORN TO AND SUBSCRIBED

BEFORE ME THIS _____ DAY

of_____, 20___.

_____ _____

Notary Public My Commission Expires

Notary Seal:

SECTION 00 15 50 – NON-DISCRIMINATION / SEXUAL HARASSMENT CLAUSE

NON-DISCRIMINATION/SEXUAL HARASSMENT CLAUSE

1. In the hiring of any employee(s) for the manufacture of supplies, performance of work, or any other activity required under the grant agreement or any subgrant agreement, contract, or subcontract, the Grantee, a subgrantee, a contractor, a subcontractor, or any person acting on behalf of the Grantee shall not discriminate by reason of race, gender, creed, color, sexual orientation, gender identity or expression, or in violation of the Pennsylvania Human Relations Act (PHRA) and applicable federal laws, against any citizen of this Commonwealth who is qualified and available to perform the work to which the employment relates.
2. The Grantee, any subgrantee, contractor or any subcontractor or any person on their behalf shall not in any manner discriminate by reason of race, gender, creed, color, sexual orientation, gender identity or expression, or in violation of the PHRA and applicable federal laws, against or intimidate any of its employees.
3. The Grantee, any subgrantee, contractor or any subcontractor shall establish and maintain a written nondiscrimination and sexual harassment policy and shall inform their employees in writing of the policy. The policy must contain a provision that sexual harassment will not be tolerated and employees who practice it will be disciplined. Posting this Nondiscrimination/Sexual Harassment Clause conspicuously in easily-accessible and well-lighted places customarily frequented by employees and at or near where the grant services are performed shall satisfy this requirement for employees with an established work site.
4. The Grantee, any subgrantee, contractor or any subcontractor shall not discriminate by reason of race, gender, creed, color, sexual orientation, gender identity or expression, or in violation of the PHRA and applicable federal laws, against any subgrantee, contractor, subcontractor or supplier who is qualified to perform the work to which the grant relates.
5. The Grantee and each subgrantee, contractor and subcontractor represents that it is presently in compliance with and will maintain compliance with all applicable federal, state, and local laws and regulations relating to nondiscrimination and sexual harassment. The Grantee and each subgrantee, contractor and subcontractor further represents that it has filed a Standard Form 100 Employer Information Report ("EEO-1") with the U.S. Equal Employment Opportunity Commission ("EEOC") and shall file an annual EEO-1 report with the EEOC as required for employers' subject to Title VII of the Civil Rights Act of 1964, as amended, that have 100 or more employees and employers that have federal government contracts or first-tier subcontracts and have 50 or more employees. The Grantee, any subgrantee, any contractor or any subcontractor shall, upon request and within the time periods requested by the Commonwealth, furnish all necessary employment documents and records, including EEO-1 reports, and permit access to their books, records, and accounts by the granting agency and the Bureau of Diversity, Inclusion and Small Business Opportunities for the purpose of ascertaining compliance with the provisions of this Nondiscrimination/Sexual Harassment Clause.
6. The Grantee, any subgrantee, contractor or any subcontractor shall include the provisions of this Nondiscrimination/Sexual Harassment Clause in every subgrant agreement, contract or subcontract so that those provisions applicable to subgrantees, contractors or subcontractors will be binding upon each subgrantee, contractor or subcontractor.
7. The Granter's and each subgrantee's, contractor's and subcontractor's obligations pursuant to these provisions are ongoing from and after the effective date of the grant agreement through the termination date thereof. Accordingly, the Grantee and each subgrantee, contractor and subcontractor shall have an obligation to inform the Commonwealth if, at any time during the term of the grant agreement, it becomes aware of any actions or occurrences that would result in violation of these provisions.
8. The Commonwealth may cancel or terminate the grant agreement and all money due or to become due under the grant agreement may be forfeited for a violation of the terms and conditions of this Nondiscrimination/Sexual Harassment Clause. In addition, the granting agency may proceed with debarment or suspension and may place the Grantee, subgrantee, contractor, or subcontractor in the Contractor Responsibility File.

Please acknowledge you have read Item above. Sign and date below.

_____ _____

Signature **Date**

RETURN WITH BID PACKAGE

PUBLIC WORK EMPLOYMENT VERIFICATION ACT

General. In accordance with Act 127 of 2012, known as the Public Works Employment Verification Act ("the Act"), effective January 1, 2013, 43 P.S. §§167.1-167.11, use the Federal Government's E-Verify system to ensure that all employees performing work on the project, including subcontractor's employees, are authorized to work in the United States.

Verification Form. Verify the employment eligibility of each new employee hired after January 1, 2013 and submit the Commonwealth Public Works Employment Verification Form ("Form") included in the bid package attachments to the Department.

Contractor. Fax the Form, signed by authorized representative of the Contractor, possessing sufficient knowledge to make the representations and certifications in the Form to Contract Awards at 717-705-1504 within 7 days of the bid opening. Failure or refusal to provide the Form will be considered a refusal to comply with bidding requirements, will result in rejection of the bid, and will be subject to the enforcement activities, sanctions and civil penalties specified in the Act.

Subcontractor. Obtain a signed Form from every subcontractor performing work on the project, signed by authorized representative of the subcontractor, possessing sufficient knowledge to make the representations and certifications in the Form and submit it to the Representative when requesting subcontractor approval. Failure or refusal to provide the Form will be considered a refusal to comply with subcontractor approval requirements, will result in rejection of the subcontractor request, and will subject the subcontractor to the enforcement activities, sanctions and civil penalties specified in the Act.

Include information about the requirements of the Act in all the subcontracts.

The Department of General Services is the Commonwealth agency responsible for enforcement and administration of the Act. Please direct questions about the Act to:

Department of General Services Public Works
Employment Verification Compliance Office
Room 105 Tent Building
18th and Herr Streets
Harrisburg, PA 17125
Fax: 717-214-3669

COMMONWEALTH OF PENNSYLVANIA

PUBLIC WORKS EMPLOYMENT VERIFICATION FORM

Date _____

Business or Organization Name (Employer)_____

Address _____

City _____ **State**_____ **Zip Code** _____

☐ **Contractor** ☐ **{dzōŏ2yŭ№I-ŏŭ2№ óŏKŜŏ] 2yŜú**

Contracting Public Body _____

Contract/Project No _____

Project Description _____

Project Location _____

As a contractor/subcontractor for the above referenced public works contract, I hereby affirm that as of the above date, our company is in compliance with the Public Works Employment Verification Act ('the Act') through utilization of the federal E-Verify Program (EVP) operated by the United States Department of Homeland Security. To the best of my/our knowledge, all employees hired post January 1, 2013 are authorized to work in the United States.

It is also agreed to that all public works contractors/subcontractors will utilize the federal EVP to verify the employment eligibility of each new hire within five (5) business days of the employee start date throughout the duration of the public works contract. Documentation confirming the use of the federal EVP upon each new hire shall be maintained in the event of an investigation or audit.

I, _____, authorized representative of the company above, attest that the information contained in this verification form is true and correct and understand that the submission of false or misleading information in connection with the above verification shall be subject to sanctions provided by law.

_____

Authorized Representative Signature

No.	Activity	Start No Earlier Than	Finish No Later Than
1	Notice to Proceed	1/4/2027	
2	Process Shop Drawings/Submittals, Begin procurement of long-lead items	1/5/2027	2/26/2027
3	Site Phase 1		6/30/2027
4	Selective Demolition prior to Abatement Work by GC	1/4/2027	1/18/2027
5	MC, EC, & PC disconnect equipment/utilities prior to Abatement Work	1/4/2027	1/18/2027
6	Building Abatement - All Floors	1/18/2027	2/19/2027
7	Building Selective Demolition - All Floors (Coordinate with Abatement)	1/4/2027	2/26/2027
8	Roof Phasing		8/31/2027
9	Building Weather Tight		8/31/2027
10	Above ceiling M/E/P/FP Complete		9/30/2027
11	Site Phase 2		10/15/2027
12	Energize Permanent Power		11/19/2027
13	Complete Mechanical, Electrical, Plumbing, & Fire Protection Start-Up		12/3/2027
14	Project Substantial Completion		12/17/2027
15	Project Final Completion		1/14/2028

SECTION 00 19 10 – PERFORMANCE AND PAYMENT BOND

The Performance and Payment Bond to be executed on behalf of the Owner is the American Institute of Architects Document A312 "Performance and Payment Bond ", 2010 Edition, bound herein, is hereby made part of the Contract Documents. Other general industry accepted Performance and Payment Bond forms may also be accepted.

Document A312 is enclosed (2 page) following for each Prime Contractor's review.

END OF SECTION 00 19 10

DRAFT

AIA® Document A312® – 2010

Performance Bond

CONTRACTOR:
(Name, legal status and address)

« »« »
« »

SURETY:
(Name, legal status and principal place of business)

« »« »
« »

OWNER:
(Name, legal status and address)

«Council Rock School District»« »
«30 North Chancellor Street»
Newtown, PA 18940»

CONSTRUCTION CONTRACT
Date: « »
Amount: $ « »
Description:
(Name and location)

«Chancellor Center Renovations»
«30 North Chancellor Street»
Newtown, PA 18940»

BOND
Date:
(Not earlier than Construction Contract Date)
« »
Amount: $ « »
Modifications to this Bond: ☐ « » None ☐ « » See Section 16

CONTRACTOR AS PRINCIPAL		SURETY	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:		Signature:	
Name and Title:	« »« »	Name and Title:	« »« »

(Any additional signatures appear on the last page of this Performance Bond.)

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or BROKER:

« »
« »
« »

OWNER'S REPRESENTATIVE:
(Architect, Engineer or other party:)

«Ms. Jessica Binda-Rischow»
«Council Rock School District»
«30 North Chancellor Street»
«Newtown, PA 18940»
«215-944-1000»
« »

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

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User Notes: (1112959090)

§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

§ 2 If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Section 3.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after

.1 the Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Section 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

.2 the Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

.3 the Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

§ 4 Failure on the part of the Owner to comply with the notice requirement in Section 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

§ 5 When the Owner has satisfied the conditions of Section 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

§ 5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

§ 5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

§ 5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Section 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

§ 5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:

.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

§ 6 If the Surety does not proceed as provided in Section 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Section 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

§ 7 If the Surety elects to act under Section 5.1, 5.2 or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the

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User Notes: (1112959090)

Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication, for

.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

.2 additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Section 5; and

.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

§ 8 If the Surety elects to act under Section 5.1, 5.3 or 5.4, the Surety's liability is limited to the amount of this Bond.

§ 9 The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors and assigns.

§ 10 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 11 Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 12 Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

§ 13 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 14 Definitions

§ 14.1 Balance of the Contract Price. The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

§ 14.2 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

§ 14.3 Contractor Default. Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

§ 14.4 Owner Default. Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 14.5 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.

§ 15 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

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§ 16 Modifications to this bond are as follows:

« »

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL		SURETY	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:		Signature:	
Name and Title:	« »« »	Name and Title:	« »« »
Address:	« »	Address:	« »

DRAFT

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AIA® Document A312® – 2010

Payment Bond

CONTRACTOR:
(Name, legal status and address)

« »« »
« »

SURETY:
(Name, legal status and principal place of business)

« »« »
« »

OWNER:
(Name, legal status and address)

«Council Rock School District»« »
«30 North Chancellor Street»
Newtown, PA 18940»

CONSTRUCTION CONTRACT
Date: « »
Amount: $ « »
Description:
(Name and location)

«Chancellor Center Renovations»
«30 North Chancellor Street»
Newtown, PA 18940»

BOND
Date:
(Not earlier than Construction Contract Date)
« »
Amount: $ « »
Modifications to this Bond: [« »] None [« »] See Section 18

CONTRACTOR AS PRINCIPAL
Company: *(Corporate Seal)*

Signature: _____
Name and Title: « »« »

SURETY
Company: *(Corporate Seal)*

Signature: _____
Name and Title: « »« »

(Any additional signatures appear on the last page of this Payment Bond.)

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or BROKER:

« »
« »
« »

OWNER'S REPRESENTATIVE:
(Architect, Engineer or other party:)

«Ms. Jessica Binda-Rischow»
«Council Rock School District»
«30 North Chancellor Street»
«Newtown, PA 18940»
«215-944-1000»
« »

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

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§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner to pay for labor, materials and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

§ 2 If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies and holds harmless the Owner from claims, demands, liens or suits by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Section 13) of claims, demands, liens or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract and tendered defense of such claims, demands, liens or suits to the Contractor and the Surety.

§ 4 When the Owner has satisfied the conditions in Section 3, the Surety shall promptly and at the Surety's expense defend, indemnify and hold harmless the Owner against a duly tendered claim, demand, lien or suit.

§ 5 The Surety's obligations to a Claimant under this Bond shall arise after the following:

§ 5.1 Claimants, who do not have a direct contract with the Contractor,

.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

.2 have sent a Claim to the Surety (at the address described in Section 13).

§ 5.2 Claimants, who are employed by or have a direct contract with the Contractor, have sent a Claim to the Surety (at the address described in Section 13).

§ 6 If a notice of non-payment required by Section 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Section 5.1.1.

§ 7 When a Claimant has satisfied the conditions of Sections 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

§ 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

§ 7.2 Pay or arrange for payment of any undisputed amounts.

§ 7.3 The Surety's failure to discharge its obligations under Section 7.1 or Section 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Section 7.1 or Section 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

§ 8 The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Section 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

§ 9 Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

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User Notes: (1835755338)

§ 10 The Surety shall not be liable to the Owner, Claimants or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to, or give notice on behalf of, Claimants or otherwise have any obligations to Claimants under this Bond.

§ 11 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 12 No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Section 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 13 Notice and Claims to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

§ 14 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 15 Upon request by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

§ 16 Definitions

§ 16.1 Claim. A written statement by the Claimant including at a minimum:

.1 the name of the Claimant;
.2 the name of the person for whom the labor was done, or materials or equipment furnished;
.3 a copy of the agreement or purchase order pursuant to which labor, materials or equipment was furnished for use in the performance of the Construction Contract;
.4 a brief description of the labor, materials or equipment furnished;
.5 the date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
.6 the total amount earned by the Claimant for labor, materials or equipment furnished as of the date of the Claim;
.7 the total amount of previous payments received by the Claimant; and
.8 the total amount due and unpaid to the Claimant for labor, materials or equipment furnished as of the date of the Claim.

§ 16.2 Claimant. An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.

§ 16.3 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

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§ 16.4 Owner Default. Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 16.5 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.

§ 17 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 18 Modifications to this bond are as follows:

« »

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL		SURETY	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:		Signature:	
Name and Title:	« »« »	Name and Title:	« »« »
Address:	« »	Address:	« »

DRAFT

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SECTION 00 19 30 – MAINTENANCE BOND

Council Rock School District Chancellor Center Renovations

18 MONTH MAINTENANCE BOND

(Please type or print clearly)

BOND # _____

(Renew each term with Maintenance Contract)

Know all men by these presents, that we, the undersigned_____as principal and as sureties, are hereby held and firmly bound unto the Council Rock School District, as Obligee,_in the penal sum of_____dollars, (15% of Contract Amount) for the payment of which well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

Signed this_____day of_____, 20___.

The condition of the above obligation is such that whereas, the above named principal did on the day of___, 20___, enter into a contract with, which said contract is made a part of this the bond the same as though set forth herein:

Now, if said_____shall well and faithfully do and perform the things agreed by_____to be done and performed according to the terms of said contract, and shall pay all lawful claims for subcontractors, materialmen, laborers, persons, firms or corporations for labor performed or materials, provisions, provender or other supplies or teams, fuels, oils, implements or machinery furnished, used or consumed in the carrying forward, performing or completing said contract, we agreeing and assenting that this undertaking shall be for the benefit of any subcontractor, materialmen, laborer, person, firm or corporation having a just claim, as well as for the Obligee herein; and shall continue said obligation for twelve months from the date of completion and acceptance of the work to be performed under the said contract to guarantee against defects in the work, which, in the judgment of the Obligee or its successors or assigns having jurisdiction in the premises, are caused by defective or inferior materials and/or workmanship, then this obligation shall be void; otherwise the same shall remain in liability of the surety for any and all claims hereunder shall in no event exceed the penal amount of this obligation as herein stated.

The said surety hereby stipulates and agrees that no modifications, omissions or additions in or to the terms of the said contract or in or to the plans or specifications therefore shall in anywise affect the obligation of said surety on its bond.

The Principal and the Surety agree that in case of default in and/or any action arising out of this Bond, the Obligee or any person, association, partnership and/or corporation who shall be entitled to institute and maintain an action upon this Bond, as above provided, may use, for the purpose of the establishment of the claim, a copy of this Bond, duly certified by the Obligee to be true and correct, and the Principal and the Surety agree that any action instituted upon any part of this Bond shall not be a bar to any subsequent action upon the same part or any other part of this Bond.

Each reference in this Bond to the Obligee shall also include the officers, employees and representatives of said Obligee.

It is the intention of the parties hereto to be legally bound by this instrument.

IN WITNESS WHEREOF, THE said Principal and Surety have duly executed this Bond in triplicate under seal and day and year first above written.

SIGNED, SEALED AND DATED THIS_____DAY OF_____, 20_ .

_____
PRINCIPAL

Attest: BY_____(L.S.)

_____
Title of Officer

_____
SECRETARY (SEAL)

_____
Surety

Attest: BY_____(L.S.)

_____
Title of Officer

_____
SECRETARY (SEAL)

SECTION 00 19 40 - CONTRACTOR QUALIFICATION STATEMENT

The Contractor Qualification Statement is the American Institute of Architect's Document A305 “Contractor Qualification Statement”, 2020 Edition, and is bound herewith.

Document A305 is enclosed (4 pages) following for each Prime Contractor’s review.

END OF SECTION 00 19 40

DRAFT

AIA® Document A305® – 2020

Contractor's Qualification Statement

THE PARTIES SHOULD EXECUTE A SEPARATE CONFIDENTIALITY AGREEMENT IF THEY INTEND FOR ANY OF THE INFORMATION IN THIS A305-2020 TO BE HELD CONFIDENTIAL.

SUBMITTED BY:
(Organization name and address.)
« »

SUBMITTED TO:
(Organization name and address.)
«Client Name»«»
«Street Address
City, State, Zip»

TYPE OF WORK TYPICALLY PERFORMED
(Indicate the type of work your organization typically performs, such as general contracting, construction manager as constructor services, HVAC contracting, electrical contracting, plumbing contracting, or other.)
« »

THIS CONTRACTOR'S QUALIFICATION STATEMENT INCLUDES THE FOLLOWING:
(Check all that apply.)

[«X»] Exhibit A – General Information
[«X»] Exhibit B – Financial and Performance Information
[«X»] Exhibit C – Project-Specific Information
[«X»] Exhibit D – Past Project Experience
[« »] Exhibit E – Past Project Experience (Continued)

CONTRACTOR CERTIFICATION
The undersigned certifies under oath that the information provided in this Contractor's Qualification Statement is true and sufficiently complete so as not to be misleading.

_____ « »
Organization's Authorized Representative Signature — Date

« »
Printed Name and Title

NOTARY
State of: « »
County of: « »
Signed and sworn to before me this « » day of « » « »

Notary Signature

My commission expires: « »

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DRAFT AIA® Document A305™ – 2020 Exhibit A

General Information

This Exhibit is part of the Contractor's Qualification Statement, submitted by « » and dated the « » day of « » in the year « »
(In words, indicate day, month and year.)

§ A.1 ORGANIZATION
§ A.1.1 Name and Location
§ A.1.1.1 Identify the full legal name of your organization.

« »

§ A.1.1.2 List all other names under which your organization currently does business and, for each name, identify jurisdictions in which it is registered to do business under that trade name.

« »

§ A.1.1.3 List all prior names under which your organization has operated and, for each name, indicate the date range and jurisdiction in which it was used.

« »

§ A.1.1.4 Identify the address of your organization's principal place of business and list all office locations out of which your organization conducts business. If your organization has multiple offices, you may attach an exhibit or refer to a website.

« »

§ A.1.2 Legal Status
§ A.1.2.1 Identify the legal status under which your organization does business, such as sole proprietorship, partnership, corporation, limited liability corporation, joint venture, or other.

« »

.1 If your organization is a corporation, identify the state in which it is incorporated, the date of incorporation, and its four highest-ranking corporate officers and their titles, as applicable.

« »

.2 If your organization is a partnership, identify its partners and its date of organization.

« »

.3 If your organization is individually owned, identify its owner and date of organization.

« »

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

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User Notes: (1463371110)

.4 If the form of your organization is other than those listed above, describe it and identify its individual leaders:

« »

§ A.1.2.2 Does your organization own, in whole or in part, any other construction-related businesses? If so, identify and describe those businesses and specify percentage of ownership.

« »

§ A.1.3 Other Information

§ A.1.3.1 How many years has your organization been in business?

« »

§ A.1.3.2 How many full-time employees work for your organization?

« »

§ A.1.3.3 List your North American Industry Classification System (NAICS) codes and titles. Specify which is your primary NAICS code.

« »

§ A.1.3.4 Indicate whether your organization is certified as a governmentally recognized special business class, such as a minority business enterprise, woman business enterprise, service disabled veteran owned small business, woman owned small business, small business in a HUBZone, or a small disadvantaged business in the 8(a) Business Development Program. For each, identify the certifying authority and indicate jurisdictions to which such certification applies.

« »

§ A.2 EXPERIENCE

§ A.2.1 Complete Exhibit D to describe up to four projects, either completed or in progress, that are representative of your organization's experience and capabilities.

§ A.2.2 State your organization's total dollar value of work currently under contract.

« »

§ A.2.3 Of the amount stated in Section A.2.2, state the dollar value of work that remains to be completed:

« »

§ A.2.4 State your organization's average annual dollar value of construction work performed during the last five years.

« »

§ A.3 CAPABILITIES

§ A.3.1 List the categories of work that your organization typically self-performs.

« »

§ A.3.2 Identify qualities, accreditations, services, skills, or personnel that you believe differentiate your organization from others.

« »

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§ A.3.3 Does your organization provide design collaboration or pre-construction services? If so, describe those services.

« »

§ A.3.4 Does your organization use building information modeling (BIM)? If so, describe how your organization uses BIM and identify BIM software that your organization regularly uses.

« »

§ A.3.5 Does your organization use a project management information system? If so, identify that system.

« »

§ A.4 REFERENCES

§ A.4.1 Identify three client references:
(Insert name, organization, and contact information)

« »

§ A.4.2 Identify three architect references:
(Insert name, organization, and contact information)

« »

§ A.4.3 Identify one bank reference:
(Insert name, organization, and contact information)

« »

§ A.4.4 Identify three subcontractor or other trade references:
(Insert name, organization, and contact information)

« »

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DRAFT AIA® Document A305™ – 2020 Exhibit B

Financial and Performance Information

This Exhibit is part of the Contractor's Qualification Statement, submitted by « » and dated the « » day of « » in the year « »
(In words, indicate day, month and year.)

§ B.1 FINANCIAL
§ B.1.1 Federal tax identification number:

« »

§ B.1.2 Attach financial statements for the last three years prepared in accordance with Generally Accepted Accounting Principles, including your organization's latest balance sheet and income statement. Also, indicate the name and contact information of the firm that prepared each financial statement.

« »

§ B.1.3 Has your organization, its parent, or a subsidiary, affiliate, or other entity having common ownership or management, been the subject of any bankruptcy proceeding within the last ten years?

« »

§ B.1.4 Identify your organization's preferred credit rating agency and identification information.
(Identify rating agency, such as Dun and Bradstreet or Equifax, and insert your organization's identification number or other method of searching your organization's credit rating with such agency.)

« »

§ B.2 DISPUTES AND DISCIPLINARY ACTIONS
§ B.2.1 Are there any pending or outstanding judgments, arbitration proceedings, bond claims, or lawsuits against your organization, its parent, or a subsidiary, affiliate, or other entity having common ownership or management, or any of the individuals listed in Exhibit A, Section 1.2, in which the amount in dispute is more than $75,000?
(If the answer is yes, provide an explanation.)

« »

§ B.2.2 In the last five years has your organization, its parent, or a subsidiary, affiliate, or other entity having common ownership or management:
(If the answer to any of the questions below is yes, provide an explanation.)

.1 failed to complete work awarded to it?

« »

.2 been terminated for any reason except for an owners' convenience?

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« »

.3 had any judgments, settlements, or awards pertaining to a construction project in which your organization was responsible for more than $75,000?

« »

.4 filed any lawsuits or requested arbitration regarding a construction project?

« »

§ B.2.3 In the last five years, has your organization, its parent, or a subsidiary, affiliate, or other entity having common ownership or management; or any of the individuals listed in Exhibit A Section 1.2:
(If the answer to any of the questions below is yes, provide an explanation.)

.1 been convicted of, or indicted for, a business-related crime?

« »

.2 had any business or professional license subjected to disciplinary action?

« »

.3 been penalized or fined by a state or federal environmental agency?

« »

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DRAFT AIA® Document A305™ – 2020 Exhibit C

Project Specific Information

This Exhibit is part of the Contractor's Qualification Statement, submitted by « » and dated the « » day of « » in the year « »
(In words, indicate day, month and year.)

PROJECT:
(Name and location or address.)

« »
« »

CONTRACTOR'S PROJECT OFFICE:
(Identify the office out of which the contractor proposes to perform the work for the Project.)

« »

TYPE OF WORK SOUGHT
(Indicate the type of work you are seeking for this Project, such as general contracting, construction manager as constructor, design-build, HVAC subcontracting, electrical subcontracting, plumbing subcontracting, etc.)

« »

CONFLICT OF INTEREST
Describe any conflict of interest your organization, its parent, or a subsidiary, affiliate, or other entity having common ownership or management, or any of the individuals listed in Exhibit A Section 1.2, may have regarding this Project.

« »

§ C.1 PERFORMANCE OF THE WORK
§ C.1.1 When was the Contractor's Project Office established?

« »

§ C.1.2 How many full-time field and office staff are respectively employed at the Contractor's Project Office?

« »

§ C.1.3 List the business license and contractor license or registration numbers for the Contractor's Project Office that pertain to the Project.

« »

§ C.1.4 Identify key personnel from your organization who will be meaningfully involved with work on this Project and indicate (1) their position on the Project team, (2) their office location, (3) their expertise and experience, and (4) projects similar to the Project on which they have worked.

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« »

§ C.1.5 Identify portions of work that you intend to self-perform on this Project.

« »

§ C.1.6 To the extent known, list the subcontractors you intend to use for major portions of work on the Project.

« »

§ C.2 EXPERIENCE RELATED TO THE PROJECT

§ C.2.1 Complete Exhibit D to describe up to four projects performed by the Contractor's Project Office, either completed or in progress, that are relevant to this Project, such as projects in a similar geographic area or of similar project type. If you have already completed Exhibit D, but want to provide further examples of projects that are relevant to this Project, you may complete Exhibit E.

§ C.2.2 State the total dollar value of work currently under contract at the Contractor's Project Office:

« »

§ C.2.3 Of the amount stated in Section C.2.2, state the dollar value of work that remains to be completed:

« »

§ C.2.4 State the average annual dollar value of construction work performed by the Contractor's Project Office during the last five years.

« »

§ C.2.5 List the total number of projects the Contractor's Project Office has completed in the last five years and state the dollar value of the largest contract the Contractor's Project Office has completed during that time.

« »

§ C.3 SAFETY PROGRAM AND RECORD

§ C.3.1 Does the Contractor's Project Office have a written safety program?

« »

§ C.3.2 List all safety-related citations and penalties the Contractor's Project Office has received in the last three years.

« »

§ C.3.3 Attach the Contractor's Project Office's OSHA 300a Summary of Work-Related Injuries and Illnesses form for the last three years.

§ C.3.4 Attach a copy of your insurance agent's verification letter for your organization's current workers' compensation experience modification rate and rates for the last three years.

§ C.4 INSURANCE

§ C.4.1 Attach current certificates of insurance for your commercial general liability policy, umbrella insurance policy, and professional liability insurance policy, if any. Identify deductibles or self-insured retentions for your commercial general liability policy.

§ C.4.2 If requested, will your organization be able to provide property insurance for the Project written on a builder's risk "all-risks" completed value or equivalent policy form and sufficient to cover the total value of the entire Project on a replacement cost basis?

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« »

§ C.4.3 Does your commercial general liability policy contain any exclusions or restrictions of coverage that are prohibited in AIA Document A101-2017, Exhibit A, Insurance A.3.2.2.2? If so, identify.

« »

§ C.5 SURETY

§ C.5.1 If requested, will your organization be able to provide a performance and payment bond for this Project?

« »

§ C.5.2 Surety company name:

« »

§ C.5.3 Surety agent name and contact information:

« »

§ C.5.4 Total bonding capacity:

« »

§ C.5.5 Available bonding capacity as of the date of this qualification statement:

« »

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DRAFT AIA® Document A305™ – 2020 Exhibit D

Contractor's Past Project Experience

	1	2	3	4
PROJECT NAME				
PROJECT LOCATION				
PROJECT TYPE				
OWNER				
ARCHITECT				
CONTRACTOR'S PROJECT EXECUTIVE				
KEY PERSONNEL (include titles)				
PROJECT DETAILS	Contract Amount Completion Date % Self-Performed Work	Contract Amount Completion Date % Self-Performed Work	Contract Amount Completion Date % Self-Performed Work	Contract Amount Completion Date % Self-Performed Work
PROJECT DELIVERY METHOD	☐ Design-bid-build ☐ Design-build ☐ CM constructor ☐ CM advisor ☐ Other:	☐ Design-bid-build ☐ Design-build ☐ CM constructor ☐ CM advisor ☐ Other:	☐ Design-bid-build ☐ Design-build ☐ CM constructor ☐ CM advisor ☐ Other:	☐ Design-bid-build ☐ Design-build ☐ CM constructor ☐ CM advisor ☐ Other:
SUSTAINABILITY CERTIFICATIONS				

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DRAFT AIA® Document A305™ – 2020 Exhibit E

Contractor's Past Project Experience, Continued

	1	2	3	4
PROJECT NAME				
PROJECT LOCATION				
PROJECT TYPE				
OWNER				
ARCHITECT				
CONTRACTOR'S PROJECT EXECUTIVE				
KEY PERSONNEL (include titles)				
PROJECT DETAILS	Contract Amount Completion Date % Self-Performed Work	Contract Amount Completion Date % Self-Performed Work	Contract Amount Completion Date % Self-Performed Work	Contract Amount Completion Date % Self-Performed Work
PROJECT DELIVERY METHOD	☐ Design-bid-build ☐ Design-build ☐ CM constructor ☐ CM advisor ☐ Other:	☐ Design-bid-build ☐ Design-build ☐ CM constructor ☐ CM advisor ☐ Other:	☐ Design-bid-build ☐ Design-build ☐ CM constructor ☐ CM advisor ☐ Other:	☐ Design-bid-build ☐ Design-build ☐ CM constructor ☐ CM advisor ☐ Other:
SUSTAINABILITY CERTIFICATIONS				

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SECTION 00 19 50 – SAFETY PRE-QUALIFICATION QUESTIONNAIRE

The Safety Pre-Qualification Questionnaire, bound herewith, is to be completed by each Bidder.

Safety Pre-Qualification Questionnaire is enclosed following for each Prime Contractor's review.

END OF SECTION 00 19 50

Subcontractor Pre-Qualification Safety Questionnaire

Job#: _____

Date: _____

Subcontractor Name: _____

Information required in this document will be provided to the above-named client. Client will Review and make all determinations regarding acceptability based on initial and any follow up Information requested.

Company Information

Address _____ Phone Number _____

City _____ Fax Number _____

State _____ Zip Code _____ e-mail _____

SIC Code _____ Yrs. In Business _____

Corp. Safety Director _____

Phone Number _____

E-mail _____

Company Background (Explain the type of work your company performs)

Section A: Experience Modification Rate

Please obtain from your insurance agent/broker/carrier, Company's EMR for the last four (4) rating periods. Contractor may be considered ineligible if current year or most recent three-year average EMR is above the identified threshold:

Experience Modification Rate Threshold (EMR) 1.0

Current Year EMR		Policy Year	
Previous Year 1		Policy Year	
Previous Year 2		Policy Year	
Previous Year 3		Policy Year	

If Contractor's current EMR, or average EMR over the most recent three (3) year period is above the identified threshold, the following information must be provided:

1. Written explanation of why contractor's EMR is above identified threshold;
2. Written outline of corrective actions currently being undertaken to reduce injuries, illnesses and Worker's Compensation losses by the contractor;
3. Copy of Contractor's Corporate Safety and Health Program
4. Name and qualification of individual(s) responsible for managing and overseeing this initiative;
5. Copy of Contractor's Worker's Compensation Loss Runs for the past 3 years.

Determinations made are based on the above information provided, as long as contractor has satisfied the requirements of Section A, even if its current or three-year average EMR is above the identified threshold.

Section B: OSHA Incident Rates

Evaluation of the Contractor's OSHA Recordable and Loss Time Incidence Rate compared to the most current data provided by the Annual Survey of Occupational Injuries and Illness conducted by the Bureau of Labor Statistics, U.S. Department of Labor (BLS). The Contractors must recent three-year (3) period will be evaluated.

Contractor may be considered ineligible if Total Recordable or Loss Time Incidence Rate average for the most recent three-year (3) period exceeds the applicable statistical standards for its business category.

Please provide your North American Industry Classification System (NAICS) Code _____

Contractor's company-wide OSHA Recordable Incidence Rate for past 3 years:

Year _____ # of Cases _____ Total Co. Hrs. Worked _____ T.R.I.R _____

Year _____ # of Cases _____ Total Co. Hrs. Worked _____ T.R.I.R _____

Year _____ # of Cases _____ Total Co. Hrs. Worked _____ T.R.I.R _____

Contractor's Company-wide OSHA Loss Time Incidence Rate for past 3 years:

Year _____ # of Cases _____ Total Co. Hrs. Worked _____ L.T.I.R _____

Year _____ # of Cases _____ Total Co. Hrs. Worked _____ L.T.I.R _____

Year _____ # of Cases _____ Total Co. Hrs. Worked _____ L.T.I.R _____

Information to assist in completing Section B, #2 and #3:

OSHA Recordable Incidence Rate = $\frac{\textit{Total \# of Recordable Cases x 200,000}}{\textit{Divided by Company Man Hours}}$

OSHA Loss Time Incidence Rate = $\frac{\textit{Total \# of Loss Time Cases x 200,000}}{\textit{Divided by Company Man Hours}}$

If Contractor's average total recordable or loss time incident rate compared to the most recent three-year (3) period exceeds the applicable statistical standards for its business category, the contractor must submit the following:

1. Written explanation why Contractor's Incidence Rate exceeds the BLS Incidence Rate;
2. Written outline of corrective actions currently being undertaken to reduce employee injuries and illnesses;
3. Copy of Contractor's Corporate Safety and Health Program;
4. Copy of Contractor's OSHA 300 log for each of the past three (3) years.

Determinations made are based on the above information provided, if the Contractor has satisfied the requirements of Section B even though it has an Incidence Rate that exceeds the BLS Incidence Rate.

Section C: OSHA History

Contractor's OSHA inspection history with respect to Serious, Repeat and Willful citations during the past five (5) year period will be evaluated.

Has Contractor received any Serious, Repeat or Willful Citations within the past five years, beginning immediately prior to the submittal of this questionnaire? This includes contested citations that have not yet been resolved.

☐ YES ☐ NO

If yes, list total number of citations by type and per year in the chart below. Submit copies of all citations and explanation of abatement actions taken to the client.

Year		Serious		Repeat		Willful		Fatality		Total	
Year		Serious		Repeat		Willful		Fatality		Total	
Year		Serious		Repeat		Willful		Fatality		Total	
Year		Serious		Repeat		Willful		Fatality		Total	
Year		Serious		Repeat		Willful		Fatality		Total	

If Contactor answered NO to having received any citations classified as Serious, Repeat, or Willful and such violations are found during the verification process, the Contractor may be considered ineligible by the client.

Section D: Safety Culture

Contractor must answer **ALL** questions in section below with either a YES or NO response. Each YES answer is worth "5" points and each NO answer is worth "0" points. Maximum possible score is 100. (For example, 20 questions with 20 answered YES equals 100; 15 answered YES equals 75.)

Minimum Required Score 80

Safety Policy and Procedure Questions:

1. Does Contractor have a written corporate safety and health program? ☐ YES ☐ NO
2. Does Contractor develop a project specific safety and health plan for each project? ☐ YES ☐ NO
3. Does Contractor clearly outline Names, Roles and Responsibility regarding safety for all management personnel assigned to a project? ☐ YES ☐ NO
4. Does Contractor implement and enforce a Substance Abuse Testing Program? ☐ YES ☐ NO

Safety Policy and Procedure Questions Cont.

5. Does Contractor perform pre-construction safety planning prior to the start of the project as well as major operations (i.e. foundation, steel erection, façade, excavation) addressing scope of work, exposures associated with work, controls necessary to eliminate or mitigate exposure? ☐ YES ☐ NO

6. Does Contractor complete Job Hazard Analysis (JHA) prior to the start of a new task identify And reviewed with crews performing the task? ☐ YES ☐ NO

7. Does Contractor assign an onsite safety representative to the project who has the authority and has been allocated sufficient time to audit and enforce safety compliance? ☐ YES ☐ NO

8. Does the Contractor implement and enforce a Fall Management program at heights in excess of six (6) feet for all trades? ☐ YES ☐ NO

9. Does Contractor conduct and document employee orientation for all workers assigned to the project? ☐ YES ☐ NO

10. Does Contractor implement an employee disciplinary action program regarding failure to comply with safety requirements and procedures? ☐ YES ☐ NO

11. Does Contractor hold its project management personnel accountable for safety performance of the project they are assigned to? ☐ YES ☐ NO

12. Does Contractor conduct ongoing job site safety audits with corrective action taken for deficiency? ☐ YES ☐ NO

13. Accident investigation performed to determine cause and corrective action to prevent reoccurrence? ☐ YES ☐ NO

14. Does Contactor provide ongoing safety training to its office and field management personnel? ☐ YES ☐ NO

15. Does Contractor provide ongoing safety training to its field labor forces? ☐ YES ☐ NO

16. Does Contractor hold and document weekly or more frequent safety meetings onsite? ☐ YES ☐ NO

17. Does Contractor hold subcontractors accountable for adhering to safety requirements and procedures set forth on the project? ☐ YES ☐ NO

18. Does Contractor employ full-time Safety Director? ☐ YES ☐ NO

19. Does Contractor identify by name and qualification competent persons assigned to project? ☐ YES ☐ NO

20. Does Contractor develop a project specific emergency response plan that is reviewed with All workers? ☐ YES ☐ NO

Contractor Score

Completed by

Name _____

Signature _____

Title _____

Date _____

SECTION 00 31 26 – EXISTING HAZARDOUS MATERIAL INFORMATION

1.1 EXISTING HAZARDOUS MATERIAL INFORMATION

This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information but are not a warranty of existing conditions. All Prime Bidders will receive the below listed items as part of the Bid Documents.

A. An existing Hazardous Materials Investigation report for the existing Chancellor Center, prepared by Element Environmental Solutions, Inc. dated September 23, 2026, is included as Specification Section 003126A.

B. An existing hazardous material investigation report for Asbestos Bulk Sampling at the existing Chancellor Center, prepared by Element Environmental Solutions, Inc. dated October 9, 2026, is included as Specification Section 003126B.

C. Environment remediation scope of work for the Project, prepared by Element Environmental Solutions, is included as Specification Section 003126C, Summary of Work – Asbestos Abatement [Environmental Abatement Contract (Contract No. 5) Specification Section No. 020900].

D. Environmental remediation scope drawings are included as part of the drawing set as ASB01, ASB02 and ASB03, prepared by Element Environmental Solutions.

1.2

A. Bidder may rely on the scope and technical information contained in the above referenced documents for the purposes of coordination and defining the scope of work that will be in the Environmental Remediation contract.

B. Bidder shall include all other work required for demolition, repair, renovation or new construction that is not listed in the Environmental scope, or that is required as a function of the Environmental scope to complete the Project.

C. Bidder shall visit the site and review all bid documents to familiarize themselves with existing conditions and the full project scope required. Should Bidder determine that additional information is required, the Bidder shall notify the Environmental Consultant or Construction Manager.

END OF SECTION 00 31 26

ELEMENT ENVIRONMENTAL
S O L U T I O N S

September 23, 2026

Jessica Binda-Rischow
Supervisor of Facilities/Physical Plant
Council Rock School District
The Chancellor Center
30 North Chancellor Street
Newtown, PA 18940

RE: Hazardous Materials Investigation
Chancellor Center (Administration Building)
E2S Project 1041.0025

Dear Jessica:

Element Environmental Solutions, Inc. (E2S) was contracted by the Council Rock School District to perform a hazardous materials investigation of the Chancellor Center (CRSD Administration Building), located at 30 N. Chancellor Street, Newtown, Pennsylvania. The purpose of the investigation was to identify any hazardous materials that could be impacted by upcoming renovation project.

Introduction

Representatives from E2S were on site on Friday, August 28, 2026, to perform the hazardous materials investigation. The investigation included a visual inspection and sampling for asbestos-containing materials (ACM) and lead based paint (LBP), a visual inspection for mercury and PCB-containing devices and equipment, and any other potentially hazardous or environmentally regulated materials. This report also includes information gathered from the limited asbestos bulk sampling (above ceiling) performed on June 3, 2026, and documented in the report dated June 12, 2026 (referenced throughout this report and included in Appendix C). Our representatives, Messrs. David Bertsch and Michael Seifrit, are Environmental Protection Agency (EPA) certified Asbestos Building Inspectors and are licensed as such by the Pennsylvania Department of Labor and Industry (Pa DLI). Mr. Bertsch is also an EPA-certified and PA-licensed Lead Inspector/Risk Assessor. See Appendix B for accreditations.

Summary

Our representatives performed an initial walkthrough of the building, both interior and exterior, to locate suspect ACM, lead based paint (LBP), and locate suspect light ballasts, light tubes, electronic devices, etc., and documented all findings on field data forms. Based upon the visual inspection, bulk samples were collected of suspect ACM and suspect LBP. The samples were submitted to an accredited laboratory for asbestos analysis by Polarized Light Microscopy (PLM) and for lead analysis by Flame Atomic Absorption Spectroscopy (Flame AAS). The laboratory utilized for this project was: EMSL Analytical, Inc. located in Cinnaminson, New Jersey. EMSL is an American Industrial Hygiene Association (AIHA) and a National Voluntary Laboratory Accreditation Program (NVLAP) accredited laboratory for asbestos PLM analysis and a National Lead Laboratory Accreditation Program (NLLAP) accredited laboratory for lead Flame AAS analysis.

Samples were not collected of suspect materials for mercury or PCBs due to destructive sampling methods required; however, E2S visually inspected labels and devices, if found, for documentation pertaining to the content of the materials. If required, assumptions were made to err on the side of caution when handling and disposing or recycling of these materials. The results and findings of the investigation are summarized below and on the referenced tables, for each material referenced above.

Asbestos

The following suspect materials were identified above the existing plaster ceilings, sampled, and determined to contain asbestos at EPA-regulated levels (>1%), based on previous sampling (6/3/26 limited bulk sampling):

- **Sound Insulation – Paper Wrap (White) – located above plaster ceilings between the wood joists in the 1871 and 1918 Buildings**
- **Pipe Insulation (above plaster ceiling) – assumed above ceilings and inside walls throughout the 1871, 1894, 1918 and 1932 Buildings (inaccessible)**

The following suspect materials were identified, sampled, and determined to contain asbestos below EPA-regulated levels (<0.25%), based on previous sampling (6/3/26 limited bulk sampling):

- Ceiling Plaster – Base Coat (Tan/Gray)

The following suspect materials were identified, sampled, and determined NOT to contain asbestos, based on previous sampling (6/3/26 limited bulk sampling):

- Ceiling Plaster – Skim Coat (White/Tan)
- Sound Insulation (Brown/Tan/Black)

The following suspect materials were identified, sampled, and determined to contain asbestos at EPA-regulated levels (>1%), during this investigation (8/28/26 hazardous materials investigation):

- **Window Caulk (Original exterior of 1871 Building, now located in the 2002 Addition)**
- **Window Glazing (Original exterior of 1871 Building, now located in the 2002 Addition)**
- **Exterior Window Caulk (1894)**
- **Exterior Window Glazing (1894)**

The following suspect materials were identified, sampled, and determined to contain asbestos below EPA-regulated levels (<1%), during this investigation (8/28/26 hazardous materials investigation):

- Exterior Door Caulk (1932)
- Exterior Window Glazing (1932)
- Wall Plaster – Texture/Paint Layer (Blue) (1894)
- Wall Plaster – Base Coat (Gray/Tan) (1918)

The following suspect materials were identified, sampled, and determined NOT to contain asbestos, during this investigation (8/28/26 hazardous materials investigation):

- Ceiling Plaster – Base and Skim Coats (1894)
- Paper Insulation between Wood Decking (1894)

- Wall Plaster – Base and Skim Coats (1932 Stairwell)
- Stair Tread Grip Strips (1932 Stairwell)
- Mastic Ends on Fiberglass-Insulated Pipe
- Drywall/Joint Compound
- Green 1' x 1' Floor Tile and Mastic (White/Black/Yellow)
- Carpet Glue (Gray/Yellow/Green)
- Sink Undercoating (White)
- White w/Gray Spec 1' x 1' Floor Tile and Mastic (Gray/White/Yellow)
- Cove Base Mastic (White)
- Drywall/Plaster Ceiling (1871 Storage/Music Storage)
- Exterior Window Caulk (1932)
- Exterior Door Caulk (1918)
- Wall Plaster – Base Coat (Gray) (1894)
- Wall Plaster – Texture/Paint Layer (White) (1918)
- Wall Plaster/Paint (Gray/Tan/Blue) (1871)
- Cove Base Mastic (Tan)
- Joint Compound (White)

Note: The existing roof systems were not sampled during this investigation. If necessary for documentation purposes, based on the scope of the renovations involving the roof systems, we can schedule sampling at a future date (coordination w/licensed roofer will be required for core sampling and patching).

Please refer to Table 1 for a summary of bulk sample analytical results, and to Table 3 for a summary of findings and estimated abatement costs for all identified ACM.

Lead

E2S performed composite lead-based paint chip sampling of various painted surfaces and components throughout the building. The EPA/HUD definition of LBP (>0.5 % wt by laboratory analysis) was used as a threshold to identify LBP. Refer to Table 2 for a summary of paint chip sample analytical results.

The following painted surfaces were identified, tested, and determined to contain lead at EPA/HUD regulated, lead-based paint (LPB) levels, as defined above:

- **Window Trim (Original exterior of 1871 Building, now located in the 2002 Addition)**
- **Interior Wood Doors/Door Trim**
- **Exterior Wood Windows/Doors/Trim**

Analysis results of all other representative painted surfaces that were sampled were less than the EPA regulated, lead-based paint (LPB) levels, as defined above, however, some of the painted surfaces contained detectable (very low) levels of lead and are considered lead-containing as defined by OSHA (see below). **Please refer to Table 2 for a summary of lead paint chip sample analytical results for each representative painted surface that was sampled.**

Surfaces containing any amounts of lead are regulated by Occupational Health and Safety Administration (OSHA) and all construction work that impacts painted components containing lead shall be performed in accordance with the OSHA Lead-in Construction Standard (29 CFR 1926.62), as applicable to the work being performed; and a proper waste management plan shall be utilized to certify that the waste properly disposed or recycled, as applicable. Contractors working on the project are responsible for fulfilling all applicable OSHA requirements pertaining to lead, as well as all other applicable federal, state or local requirements or regulations pertaining to lead-in construction.

In addition, for the surfaces and components where LBP was identified (as listed above), assuming the project is not deemed a "lead abatement" project, there is no requirement that the work be performed by a licensed lead abatement contractor and personnel; however, if the future use of the facility is defined as "child-occupied" or "target housing" by the EPA, there is a requirement that the work be performed by a licensed EPA Lead Renovator and personnel, and a requirement to follow the EPA Renovation, Repair and Painting (RRP) Rule for renovation projects impacting LBP, only if applicable to the work performed and future use of the facility (present use of CRSD Admin - RRP does not apply).

PCB's, Mercury, and Other Suspect Hazardous Materials

Light ballasts were randomly inspected, and ballasts visually checked were determined to be either Philips Advance or Sylvania Quicktronic® (electronic ballasts), both labeled with the "No PCB's" notation. However, not all ballasts were checked, and PCB ballasts (ballasts not labeled "No PCB's") may be present. The ballasts which are demarcated as non-PCB containing may be recycled as non-PCB ballasts in accordance with applicable industry standards for those types of ballasts (electronic ballasts). PCB ballasts, if encountered, should be recycled as PCB ballasts in a facility that accepts PCB ballasts as universal waste. Any leaking ballasts would need to be disposed of as hazardous waste unless testing is performed to classify the waste for PCBs, as applicable.

Fluorescent light tubes were also visually inspected, and those visually checked were determined to be manufactured by either Philips or Sylvania, and are assumed to contain amounts of mercury that could deem them "hazardous waste" for disposal purposes (some tubes were labeled with the Mercury elemental symbol Hg). E2S recommends that all tubes be removed prior to demolition of the lighting fixtures, if included in the renovation scope of work, and sent for recycling as universal waste, to a facility that accepts mercury-containing light tubes as part of their universal waste program.

E2S visually inspected electrical and mechanical equipment and devices, and any other suspect hazardous materials, and identified thermometers in mechanical spaces that could potentially contain mercury. No suspect PCB-containing (oil) transformers were identified, just dry-type transformers, which contain no suspected oil. We recommend a certified recycling facility is utilized to handle all mercury/PCB and other hazardous material recycling and disposal (universal waste).

Please refer to Table 3 for a breakdown of estimated abatement costs for all hazardous materials identified including costs for PCB's and Mercury recycling. Estimated recycling costs for mercury and PCB containing items are based upon pricing lists for reputable recycling facilities and include recycling fees only; transportation fees and labor costs to remove light fixtures/devices are not included. We recommend a certified recycling facility be utilized to handle all mercury/PCB hazardous material recycling, as necessary.

Please refer to Table 1 for a summary of asbestos bulk sampling and results, Table 2 for a summary of lead-based paint chip sampling and results, and Table 3 for a summary of findings and cost estimates for abatement of identified hazardous materials. Laboratory analytical reports from EMSL Analytical, Inc. for the PLM asbestos bulk samples and Flame AAS paint chip samples collected by E2S can be found in Appendix A, accreditations (certifications and licenses) for E2S representatives can be found in Appendix B, and the limited asbestos bulk sampling (above ceiling) report, dated June 12, 2026, can be found in Appendix C.

Thank you for the opportunity to present Element Environmental Solutions (E2S) as a partner in your environmental management efforts. Should you have questions or require additional information, please contact me.

Sincerely,
E2S, Inc.

David C. Bertsch
Operations Manager, IAQ

Table 1 - Asbestos Bulk Sample Analytical Results - CRSD Chancellor Center (Admin) - August 28, 2026

Sample Number	Location	Material Description	Analytical Result (PLM)
CC-8/28-01BK-Plaster	1894 Bldg - 1st Floor Corridor	Ceiling Plaster - Base Coat (Gray/Rust)	None Detected
CC-8/28-01BK-Skim Coat	1894 Bldg - 1st Floor Corridor	Ceiling Plaster - Skim Coat (White)	None Detected
CC-8/28-02BK	1894 Bldg - 1st Floor Corridor	Paper Insulation between Wood Decking	None Detected
CC-8/28-03BK-Plaster	1932 Bldg - Stairwell	Wall Plaster - Base Coat (Gray)	None Detected
CC-8/28-03BK-Skim Coat	1932 Bldg - Stairwell	Wall Plaster - Skim Coat (White)	None Detected
CC-8/28-04BK	1932 Bldg - Stairwell	Stair Tread Grip Strips (Tan/Black)	None Detected
CC-8/28-05BK	1918 Bldg - 1st Floor Corridor	Mastic End on Fiberglass-Insulated Pipe	None Detected
CC-8/28-06BK-Drywall	1918 Bldg - 1st Floor Corridor	Drywall	None Detected
CC-8/28-06BK-JC	1918 Bldg - 1st Floor Corridor	Joint Compound	None Detected
CC-8/28-07BK	**1871/2002 Bldg - 2nd Floor Work Rm**	**Window Caulk (Original exterior of 1871 Bldg)**	**3% Chrysotile**
CC-8/28-08BK	**1871/2002 Bldg - 2nd Floor Work Rm**	**Window Glazing (Original exterior of 1871 Bldg)**	**4% Chrysotile**
CC-8/28-09BK-FT	1871 Bldg - Ground Floor Corridor	Green 1' x 1' Floor Tile	None Detected
CC-8/28-09BK-Mastic	1871 Bldg - Ground Floor Corridor	1' x 1' Floor Tile Mastic (White/Black/Yellow)	None Detected
CC-8/28-10BK	1871 Bldg - Ground Floor Corridor	Carpet Glue (Gray/Yellow/Green)	None Detected
CC-8/28-11BK	1871 Bldg - Ground Floor Corridor	Sink Undercoating (White)	None Detected
CC-8/28-12BK-FT	1918 Bldg - Ground Floor Work Rm	White w/Gray Spec 1' x 1' Floor Tile	None Detected
CC-8/28-12BK-Mastic	1918 Bldg - Ground Floor Work Rm	1' x 1' Floor Tile Mastic (Gray/White/Yellow)	None Detected
CC-8/28-13BK	1918 Bldg - Ground Floor Work Rm	Cove Base Mastic (White)	None Detected
CC-8/28-14BK	1871 Bldg - Ground Floor Storage	Drywall/Plaster Ceiling	None Detected
CC-8/28-15BK-Drywall	1871 Bldg - Ground Floor Music Storage	Drywall/Plaster Ceiling (Drywall Layer)	None Detected
CC-8/28-15BK-Plaster	1871 Bldg - Ground Floor Music Storage	Drywall/Plaster Ceiling (Plaster Base Coat)	None Detected
CC-8/28-15BK-Skim Coat	1871 Bldg - Ground Floor Music Storage	Drywall/Plaster Ceiling (Plaster Skim Coat)	None Detected
CC-8/28-16BK	**1894 Bldg - Exterior**	**Window Caulk**	**3% Chrysotile**
CC-8/28-17BK	**1894 Bldg - Exterior**	**Window Glazing**	**2% Chrysotile**
CC-8/28-18BK	1932 Bldg - Exterior	Door Caulk	*<1% Chrysotile*
CC-8/28-19BK	1932 Bldg - Exterior	Window Caulk	None Detected
CC-8/28-20BK	1932 Bldg - Exterior	Window Glazing	*<1% Chrysotile*
CC-8/28-21BK	1918 Bldg - Exterior	Door Caulk	None Detected
CC-8/28-22BK-Plaster	1894 Bldg - Storage	Wall Plaster - Base Coat (Gray)	None Detected
CC-8/28-22BK-Texture	1894 Bldg - Storage	Wall Plaster - Texture/Paint Layer (Blue)	*<1% Chrysotile*
CC-8/28-23BK-Plaster	1918 Bldg - Classroom 2 Closet	Wall Plaster - Base Coat (Gray/Tan)	*<1% Chrysotile*
CC-8/28-23BK-Texture	1918 Bldg - Classroom 2 Closet	Wall Plaster - Texture/Paint Layer (White)	None Detected
CC-8/28-24BK	1871 Bldg - IT Director Closet	Wall Plaster/Paint (Gray/Tan/Blue)	None Detected
CC-8/28-25BK-Mastic	1871 Bldg - IT Director Closet	Cove Base Mastic (Tan)	None Detected
CC-8/28-25BK-Joint Compound	1871 Bldg - IT Director Closet	Joint Compound (White)	None Detected

EPA definition of asbestos-containing material (ACM) = >1% asbestos (line items BOLD)

Table 2 - Lead Paint Chip Sample Analytical Results - CRSD Chancellor Center (Admin) - August 28, 2026

Sample Number	Location	Material Description	Analytical Result (Flame AAS)
CC-8/28-01PC	**1871/2002 Bldg - Work Rm**	**Window Trim (Original Exterior of 1871 Bldg)**	**18 % wt**
CC-8/28-02PC	Throughout Interior (Composite)	Plaster Walls/Ceilings	0.014 % wt
CC-8/28-03PC	**Throughout Interior (Composite)**	**Wood Doors/Door Trim**	**0.63 % wt**
CC-8/28-04PC	Throughout Interior (Composite)	Wood Windows/Trim/Baseboards/Wainscotting	0.077 % wt
CC-8/28-05PC	**Exterior (Composite)**	**Wood Windows/Doors/Trimwork**	**1.5 % wt**

EPA definition of lead-based paint (LBP) = > 0.5% lead (line items BOLD)

Table 3 - Summary of Findings and Estimated Removal Costs - CRSD Chancellor Center (Admin) - August 28, 2026

Location	Floor	Material Description	Estimated Quantity	Estimated Cost
1871 Building (Assumed Throughout)	First	ACM Soundproofing Insulation - Paper Wrap (Above Plaster Ceilings - Between Joists)*	1,700 S.F.	$34,000.00
1918 Building (Assumed Throughout)	First	ACM Soundproofing Insulation - Paper Wrap (Above Plaster Ceilings - Between Joists)*	4,650 S.F.	$93,000.00
1871/2002 Buildings	First/Second	Window Caulk/Glazing (Original Exterior of 1871 Bldg - now part of the 2002 addition)	4 Windows	$2,000.00
1932 Building	First	ACM Pipe Insulation (Above Plaster Ceiling - Includes Demo to Access)**	5 L.F.	$1,000.00
Exterior - 1894 Building	Ground	ACM Window Caulk/Glazing	5 Windows	$2,500.00
Throughout	TBD	Inaccessible ACM (Above hard ceilings, inside walls, etc.)	TBD	$10,000.00
Throughout	First/Second	Original Chalkboard Adhesive (Assumed ACM) - **not part of current renovation scope**	Not Quantified	$0.00
Mobilization Fee			1	$1,500.00
TOTAL - Asbestos Abatement - Estimated Removal Costs (includes all known and assumed ACM, actual abatement required depends on the scope of the renovations)				**$144,000.00**
Throughout		Mercury-Containing Light Tubes (Assumed)	224 Tubes	$225.00
Throughout		Light Ballasts (No PCB's)	112 Ballasts	$225.00
Mechanical Spaces, etc.		Mercury Thermometers (Assumed)	Not Quantified	$500.00
TOTAL - Hazardous Materials (Recycling fees only, does not include labor for removal or transportation fees)				**$950.00**

Note: Estimated asbestos abatement/removal costs are based on typical unit costs assuming all materials are removed during one (1) site mobilization. If materials are removed in small quanitites, a minimum contractor mobilization fee of $1,500-$2,000 should be added to the estimated costs, as applicable.

*Estimated quantities include entire 1871/1918 building S.F., ACM was identified through 1 opening in the 1871 corridor and 2 openings in the 1918 building (Seminar Room and Historic Classroom 2). Actual abatement to be determined based on demolition scope involving plaster ceilings. Estimated cost includes demolition of existing plaster ceilings and the ACM soundproofing insulation - Paper Wrap.

**Additional inaccessible (Above hard ceilings, inside walls, etc.) ACM pipe insulation may exist throughout the 1871, 1894, 1918 and 1932 buildings (to be determined based on demo scope)

ACM = Asbestos-Containing Material

Appendix A

Laboratory Analytical Reports – EMSL Analytical, Inc.

Asbestos Bulk - Polarized Light Microscopy (PLM)

Lead Paint Chip – Flame Atomic Absorption Spectroscopy (Flame AAS)

EMSL Analytical, Inc.

200 Route 130 North Cinnaminson, NJ 08077

Tel/Fax: (800) 220-3675 / (856) 786-5974

http://www.EMSL.com / cinnasblab@EMSL.com

EMSL Order:	042618505
Customer ID:	ELES42
Customer PO:	1041.0025
Project ID:	

Attention:	David Bertsch	**Phone:**	(717) 484-5111
	Element Environmental Solutions, Inc.	**Fax:**	
	61 Willow Street	**Received Date:**	09/01/2026 10:00 AM
	PO Box 921	**Analysis Date:**	09/09/2026
	Adamstown, PA 19501	**Collected Date:**	08/28/2026
Project:	CRSD - Chancellor - Center Admin		

Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
CC-8/28-01BK-Plaster *042618505-0001*	1894 Bldg - 1st Floor Corridor - Ceiling Plaster	Gray/Rust Fibrous Homogeneous	2% Hair	45% Quartz 53% Non-fibrous (Other)	None Detected
CC-8/28-01BK-Skim Coat *042618505-0001A*	1894 Bldg - 1st Floor Corridor - Ceiling Plaster	White Non-Fibrous Homogeneous		25% Ca Carbonate 75% Non-fibrous (Other)	None Detected
CC-8/28-02BK *042618505-0002*	1894 Bldg - 1st Floor Corridor - Paper between Wood Ceiling Deck	Brown/Black Fibrous Heterogeneous	70% Cellulose 5% Synthetic	25% Non-fibrous (Other)	None Detected
CC-8/28-03BK-Plaster *042618505-0003*	1932 Bldg - Stairwell - Wall Plaster	Gray Non-Fibrous Homogeneous		40% Quartz 60% Non-fibrous (Other)	None Detected
CC-8/28-03BK-Skim Coat *042618505-0003A*	1932 Bldg - Stairwell - Wall Plaster	White Non-Fibrous Homogeneous		10% Quartz 20% Ca Carbonate 70% Non-fibrous (Other)	None Detected
CC-8/28-04BK *042618505-0004* *Result includes a small amount of inseparable attached material*	1932 Bldg - Stairwell - Stair Tread Grip Strips	Tan/Black Fibrous Heterogeneous	65% Cellulose	35% Non-fibrous (Other)	None Detected
CC-8/28-05BK *042618505-0005*	1918 Bldg - 1st Floor Corr. - Mastic End of FGIP	White Non-Fibrous Homogeneous		15% Ca Carbonate 85% Non-fibrous (Other)	None Detected
CC-8/28-06BK-Drywall *042618505-0006*	1918 Bldg - 1st Floor Corr. - Drywall	Brown/White Fibrous Homogeneous	15% Cellulose 3% Glass	40% Gypsum 42% Non-fibrous (Other)	None Detected
CC-8/28-06BK-JC *042618505-0006A*	1918 Bldg - 1st Floor Corr. - JC	White Non-Fibrous Homogeneous		65% Ca Carbonate 35% Non-fibrous (Other)	None Detected
CC-8/28-07BK *042618505-0007*	2002 Bldg - 2nd Fl Work Rm - Original Window Caulk	Gray/White/Black Fibrous Heterogeneous	2% Fibrous (Other)	25% Ca Carbonate 70% Non-fibrous (Other)	**3% Chrysotile**
CC-8/28-08BK *042618505-0008*	2002 Bldg - 2nd Fl Work Rm - Original Window Glazing	Tan/White Fibrous Heterogeneous		30% Ca Carbonate 66% Non-fibrous (Other)	**4% Chrysotile**
CC-8/28-09BK-FT *042618505-0009*	1871 Bldg - Ground Floor Corr. - Green 1x1 FT	Green Non-Fibrous Homogeneous		10% Quartz 90% Non-fibrous (Other)	None Detected
CC-8/28-09BK-Mastic *042618505-0009A*	1871 Bldg - Ground Floor Corr. - Mastic	White/Black/Yellow Fibrous Heterogeneous	5% Cellulose	20% Ca Carbonate 75% Non-fibrous (Other)	None Detected
CC-8/28-10BK *042618505-0010*	1871 Bldg - Ground Floor Corr. - Carpet Glue	Gray/Yellow/Green Fibrous Heterogeneous	3% Cellulose	20% Ca Carbonate 77% Non-fibrous (Other)	None Detected
CC-8/28-11BK *042618505-0011*	1871 Bldg - Ground Floor Corr. - Sink Undercoating (White)	White Fibrous Homogeneous	25% Cellulose	75% Non-fibrous (Other)	None Detected

Initial report from: 09/09/2026 14:27:49

EMSL Analytical, Inc.
200 Route 130 North Cinnaminson, NJ 08077
Tel/Fax: (800) 220-3675 / (856) 786-5974
http://www.EMSL.com / cinnasblab@EMSL.com

EMSL Order: 042618505
Customer ID: ELES42
Customer PO: 1041.0025
Project ID:

Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
CC-8/28-12BK-FT *042618505-0012*	1918 Bldg - Ground Fl Work Room - White w/ Gray Spec 1x1 FT	Gray/White Non-Fibrous Homogeneous		10% Quartz 90% Non-fibrous (Other)	None Detected
CC-8/28-12BK-Mastic *042618505-0012A*	1918 Bldg - Ground Fl Work Room - Mastic	Gray/White/Yellow Non-Fibrous Heterogeneous		25% Ca Carbonate 75% Non-fibrous (Other)	None Detected
CC-8/28-13BK *042618505-0013*	1918 Bldg - Ground Fl Work Room - Cove Base Mastic	White Non-Fibrous Homogeneous		15% Ca Carbonate 85% Non-fibrous (Other)	None Detected
CC-8/28-14BK *042618505-0014*	1871 Bldg - Ground Fl Storage - Drywall/Plaster Ceiling	Brown/Gray Fibrous Homogeneous	15% Cellulose	40% Gypsum 5% Perlite 40% Non-fibrous (Other)	None Detected
CC-8/28-15BK-Drywall *042618505-0015*	1871 Bldg - Ground Fl Music Storage - Drywall/Plaster Ceiling	Brown/Gray Fibrous Homogeneous	15% Cellulose	45% Gypsum 40% Non-fibrous (Other)	None Detected
CC-8/28-15BK-Plaster *042618505-0015A*	1871 Bldg - Ground Fl Music Storage - Drywall/Plaster Ceiling	Gray Non-Fibrous Homogeneous		45% Gypsum 10% Perlite 45% Non-fibrous (Other)	None Detected
CC-8/28-15BK-Skim Coat *042618505-0015B*	1871 Bldg - Ground Fl Music Storage - Drywall/Plaster Ceiling	White Non-Fibrous Homogeneous		30% Quartz 15% Ca Carbonate 55% Non-fibrous (Other)	None Detected
CC-8/28-16BK *042618505-0016*	Exterior - 1894 Bldg - Window Caulk	Gray/White Fibrous Heterogeneous		25% Ca Carbonate 72% Non-fibrous (Other)	**3% Chrysotile**
CC-8/28-17BK *042618505-0017*	Exterior - 1894 Bldg - Window Glazing	Tan/White Fibrous Heterogeneous		25% Ca Carbonate 73% Non-fibrous (Other)	**2% Chrysotile**
CC-8/28-18BK *042618505-0018* *Inseparable paint / coating layer included in analysis*	Exterior - 1932 Bldg - Door Caulk	White Fibrous Heterogeneous		25% Ca Carbonate 75% Non-fibrous (Other)	**<1% Chrysotile**
CC-8/28-19BK *042618505-0019*	Exterior - 1932 Bldg - Window Caulk	Gray/White Non-Fibrous Heterogeneous		25% Ca Carbonate 75% Non-fibrous (Other)	None Detected
CC-8/28-20BK *042618505-0020*	Exterior - 1932 Bldg - Window Glazing	Tan/White Fibrous Heterogeneous		30% Ca Carbonate 70% Non-fibrous (Other)	**<1% Chrysotile**
CC-8/28-21BK *042618505-0021*	Exterior - 1918 Bldg - Door Caulk	Brown/White Non-Fibrous Heterogeneous		10% Ca Carbonate 90% Non-fibrous (Other)	None Detected
CC-8/28-22BK-Plaster *042618505-0022*	1894 Bldg - Storage - Wall Plaster	Gray Non-Fibrous Homogeneous		30% Quartz 70% Non-fibrous (Other)	None Detected
CC-8/28-22BK-Texture *042618505-0022A*	1894 Bldg - Storage - Wall Texture	Blue Fibrous Homogeneous		15% Quartz 85% Non-fibrous (Other)	**<1% Chrysotile**
CC-8/28-23BK-Plaster *042618505-0023*	1918 Bldg - CR 2 Closet - Wall Plaster	Gray/Tan Fibrous Heterogeneous		35% Quartz 65% Non-fibrous (Other)	**<1% Chrysotile**
CC-8/28-23BK-Texture *042618505-0023A*	1918 Bldg - CR 2 Closet - Wall Texture	White Non-Fibrous Homogeneous		25% Ca Carbonate 75% Non-fibrous (Other)	None Detected

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EMSL Analytical, Inc.
200 Route 130 North Cinnaminson, NJ 08077
Tel/Fax: (800) 220-3675 / (856) 786-5974
http://www.EMSL.com / cinnasblab@EMSL.com

EMSL Order:	042618505
Customer ID:	ELES42
Customer PO:	1041.0025
Project ID:	

Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
CC-8/28-24BK *042618505-0024* *Inseparable paint / coating layer included in analysis*	1871 Bldg - IT Dir. Closet - Wall Plaster	Gray/Tan/Blue Fibrous Heterogeneous	3% Cellulose	35% Quartz 62% Non-fibrous (Other)	None Detected
CC-8/28-25BK-Mastic *042618505-0025*	1871 Bldg - IT Dir. Closet - Cove Base Mastic	Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
CC-8/28-25BK-Joint Compound *042618505-0025A*	1871 Bldg - IT Dir. Closet - Joint Compound	White Non-Fibrous Homogeneous		60% Ca Carbonate 40% Non-fibrous (Other)	None Detected

Analyst(s)
Jannat Fareen (35)

Samantha Sweeney, Laboratory Manager
or Other Approved Signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. The above analyses were performed in general compliance with Appendix E to Subpart E of 40 CFR (previously EPA 600/M4-82-020 “Interim Method”) but augmented with procedures outlined in the 1993 (”final”) version of the method. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Estimation of uncertainty is available on request.

Samples analyzed by EMSL Analytical, Inc. Cinnaminson, NJ NVLAP Lab Code 101048-0, AIHA LAP, LLC-IHLAP Lab 100194, PA ID# 68-00367, LA #04127

Initial report from: 09/09/2026 14:27:49

OrderID: 042618505

EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

Asbestos Bulk Building Material Chain of Custody

EMSL Order Number (*Lab Use Only*): 042618505

EMSL Analytical, Inc.
200 Route 130 North
Cinnaminson, NJ 08077
PHONE: 1-800-220-3675
FAX: (856) 786-5974

Company : Element Environmental Solutions	**EMSL-Bill to:** ☑ Same ☐ Different If Bill to is Different note instructions in Comments** *Third Party Billing requires written authorization from third party*
Street: 61 Willow Street PO Box 921	
City: Adamstown **State/Province:** PA	**Zip/Postal Code:** 19501 **Country:** United States
Report To (Name): David Bertsch	**Telephone #:** 717-484-5111
Email Address: IAQ@e2s.us	**Fax #:** **Purchase Order:** 1041-0025
Project Name/~~Number~~: CRSD - Chancellor Center Admin	**Please Provide Results:** ☐ Fax ✓ Email ☐ Mail
U.S. State Samples Taken: PA	**CT Samples:** ☐ Commercial/Taxable ☐ Residential/Tax Exempt

Turnaround Time (TAT) Options* – Please Check

☐ 3 Hour ☐ 6 Hour ☐ 24 Hour ☐ 48 Hour [redacted] ☐ 96 Hour ☒ 1 Week ☐ 2 Week

*For TEM Air 3 hr through 6 hr, please call ahead to schedule. *There is a premium charge for 3 Hour TEM AHERA or EPA Level II TAT. You will be asked to sign an authorization form for this service. Analysis completed in accordance with EMSL's Terms and Conditions located in the Analytical Price Guide.

PLM - ~~Bulk (reporting limit)~~	TEM – Bulk
☒ PLM EPA 600/R-93/116 (<1%)	☐ TEM EPA NOB – EPA 600/R-93/116 Section 2.5.5.1
☐ PLM EPA NOB (<1%)	☐ NY ELAP Method 198.4 (TEM)
Point Count ☐ 400 (<0.25%) ☐ 1000 (<0.1%)	☐ Chatfield Protocol (semi-quantitative)
Point Count w/Gravimetric ☐ 400 (<0.25%) ☐ 1000 (<0.1%)	☐ TEM % by Mass – EPA 600/R-93/116 Section 2.5.5.2
☐ NIOSH 9002 (<1%)	☐ TEM Qualitative via Filtration Prep Technique
☐ NY ELAP Method 198.1 (friable in NY)	☐ TEM Qualitative via Drop Mount Prep Technique
☐ NY ELAP Method 198.6 NOB (non-friable-NY)	**Other**
☐ OSHA ID-191 Modified	☐
☐ Standard Addition Method	

RECEIVED EMSL CINNAMINSON, NJ 2026 SEP 11 P 12: 32

☐ **Check For Positive Stop – Clearly Identify Homogenous Group** **Date Sampled:** 8-28-26

Samplers Name: David Bertsch **Samplers Signature:** [signature]

Sample #	HA #	Sample Location	Material Description
CC-8/28	-01BK	1894 Bldg - 1st Floor Corridor	Ceiling Plaster
-	02BK	↓ - ↓	Paper Between wood Ceiling Deck
-	-03BK	1932 Bldg - Stairwell	Wall Plaster
-	-04BK	↓ - ↓	Stair Tread Grip Strips
-	-05BK	1918 Bldg - 1st Floor Corr.	Mastic End on FHP
-	-06BK	↓ - ↓ ↓	Drywall / JC
-	-07BK	2002 Bldg - 2nd Fl work Rm	Original Window caulk
-	-08BK	↓ - ↓ ↓	Original Window Glazing
-	-09BK	1871 Bldg - Grand Floor Corr	Green 1x1 FT/M
↓	-10BK	↓ - ↓ ↓	Carpet Glue

Client Sample # (s): - **Total # of Samples:** 25

Relinquished (Client): [signature] **Date:** 8/31/26 **Time:** FedEx

Received (Lab): Kertulli T. EFx **Date:** 9/1/26 **Time:** 10:00am

Comments/Special Instructions:

2 SEC

EMSL Analytical, Inc.
200 Route 130 North

Cinnaminson, NJ 08077
PHONE: 1-800-220-3675
FAX: (856) 786-5974

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Asbestos Bulk Building Material Chain of Custody

EMSL Order Number *(Lab Use Only)*: 0426185 05

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information

Sample #	HA #	Sample Location	Material Description
CC-8/28-	11BK	1871 Bldg - Grand Floor Corr	Sink Undercoating (white)
	12BK	1918 Bldg Grand Fl Work Room	White w/Gray Spec 1x1 FT/M
	13BK	↓ ↓	Cove Base Mastic
	14BK	1871 Bldg Grand Fl Storage	Drywall/Plaster Ceiling
	15BK	↓ ↓ Music Storage	↓ ↓
	16BK	Exterior - 1894 Bldg	Window Caulk
	17BK	↓ - ↓ ↓	Window Glazing
	18BK	- 1932 Bldg	Door Caulk
	19BK	-	Window Caulk
	20BK	- ↓ ↓	Window Glazing
	21BK	↓ - 1918 Bldg	Door Caulk
	22BK	1894 Bldg - Stair	Wall Plaster
	23BK	1918 Bldg - CR 2 Closet	↓
	24BK	1871 Bldg - IT Dis. Closet	
↓	25BK	↓ ↓	Cove Base Mastic

*Comments/Special Instructions:

RECEIVED EMSL CINNAMINSON, NJ 2006 SEP -1 P 12:32

Page 2 of 2 pages

EMSL Analytical, Inc.

200 Route 130, Cinnaminson, NJ, 08077
Telephone: 856-858-4800 Fax:cs@emsl.com
www.emsl.com

EMSL Order ID: 012634979
LIMS Reference ID: AE34979
EMSL Customer ID: ELES42

Attention: Dave Bertsch
Element Environmental Solutions, Inc. [ELES42]
61 Willow Street, PO Box 921
Adamstown, PA 19501
(717) 484-5111
IAQ@e2s.us

Project Name: CRSD - Chancellor Center Admin

Customer PO: 1041.0025
EMSL Sales Rep: John LaFleur
Received: 09/01/2026 12:00
Reported: 09/08/2026 19:15

Analytical Results

Analyte	Results	RL	Weight	Prep Date & Tech	Prep Method	Analysis Date & Analyst	Analytical Method	Q	DF
Client Sample ID: CC-8/28-01PC/2002 Bldg - 2nd Floor Work Rm - Original Window Trim								**Date Sampled: 08/28/26**	
Matrix: Chips								**LIMS Reference ID: AE34979-01**	
Lead	18 % wt	1.3 % wt	0.2414 g	09/08/26 IxW	SW-846 3050B	09/08/26 PMx	SW846-7000B	Pb7, D	200
Client Sample ID: CC-8/28-02PC/Throughout (Composite) - Plaster Walls/Ceilings								**Date Sampled: 08/28/26**	
Matrix: Chips								**LIMS Reference ID: AE34979-02**	
Lead	0.014 % wt	0.0065 % wt	0.2466 g	09/08/26 IxW	SW-846 3050B	09/08/26 PMx	SW846-7000B	Pb7	1
Client Sample ID: CC-8/28-03PC/Throughout (Composite) - Doors/Trim								**Date Sampled: 08/28/26**	
Matrix: Chips								**LIMS Reference ID: AE34979-03**	
Lead	0.63 % wt	0.033 % wt	0.2454 g	09/08/26 IxW	SW-846 3050B	09/08/26 PMx	SW846-7000B	Pb7, D	5
Client Sample ID: CC-8/28-04PC/Throughout (Composite) - Interior Window Trim/Baseboards								**Date Sampled: 08/28/26**	
Matrix: Chips								**LIMS Reference ID: AE34979-04**	
Lead	0.077 % wt	0.0064 % wt	0.2598 g	09/08/26 IxW	SW-846 3050B	09/08/26 PMx	SW846-7000B	Pb7	1
Client Sample ID: CC-8/28-05PC/Exterior (Composite) - Windows/Doors/Trims								**Date Sampled: 08/28/26**	
Matrix: Chips								**LIMS Reference ID: AE34979-05**	
Lead	1.5 % wt	0.062 % wt	0.2578 g	09/08/26 IxW	SW-846 3050B	09/08/26 PMx	SW846-7000B	Pb7, D	10

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Project Name: CRSD - Chancellor Center Admin

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EMSL Sales Rep: John LaFleur
Received: 09/01/2026 12:00
Reported: 09/08/2026 19:15

Certified Analyses included in this Report

Analyte	Certifications
SW846-7000B in Chips	
Lead	AIHA LAP

List of Certifications

Code	Description	Number	Expires
NJDEP	New Jersey Department of Environmental Protection	03036	06/30/2027
AIHA LAP	American Industrial Hygiene Association (AIHA LAP, LLC)	100194	04/01/2027
NYSDOH	New York State Department of Health ELAP	10872	04/01/2027
California ELAP	California Water Boards	1877	06/30/2027
A2LA	A2LA Environmental Certificate	2845.01	07/31/2028
21-A2LA	A2LA Food Chem/Mat Sci	2845.15	07/31/2028
PADEP	Pennsylvania Department of Environmental Protection	68-00367	11/30/2026
HIDOH	Hawaii Department of Health	HI via NJ 03036	06/30/2027
MADEP	Massachusetts Department of Environmental Protection	M-NJ337	06/30/2027
CTDPH	Connecticut Department of Public Health	PH-0270	06/30/2028

Please see the specific Field of Testing (FOT) on www.emsl.com <http://www.emsl.com> for a complete listing of parameters for which EMSL is certified.

Notes and Definitions

Item	Definition
D	Analyte was reported from a dilution run.
Pb3	The QC sample duplicate RPD result for Lead was outside of the method control limits.
Pb7	The RLVS recovery for Lead was outside of the method control limits.
(Dig)	For metals analysis, sample was digested.
[2C]	Reported from the second channel in dual column analysis.
DA	Direct Analysis
DF	Dilution Factor
MDL	Method Detection Limit.
ND	Analyte was NOT DETECTED at or above the reporting limit, or the mdl if provided.
NR	Spike/Surrogate showed no recovery.
Q	Qualifier
RCS	Respirable Crystalline Silica
RL	Reporting Limit For paint chips, the RL is 0.0064% by wt. (equiv. to 64 mg/kg, or ppm) based upon a minimum sample weight of 0.25 grams. For soils, the RL is 32 mg/kg (ppm) based upon a minimum sample weight of 0.5 grams. For dust wipes, the RL is 8 µg/wipe; reporting units of µg/sq. ft. are not validated by the lab based upon data provided by non-lab personnel.
Wet	Sample is not dry weight corrected.

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Project Name: CRSD - Chancellor Center Admin

Customer PO: 1041.0025
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Received: 09/01/2026 12:00
Reported: 09/08/2026 19:15

Measurement of uncertainty and any applicable definitions of method modifications are available upon request. Per EPA NLLAP policy, sample results are not blank corrected.

Owen McKenna Laboratory Manager or other approved signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. QC sample results are within quality control criteria and met method specifications unless otherwise noted. All results for soil samples are reported on a dry weight basis, unless otherwise noted.

Analysis following EMSL SOP for the Determination of Environmental Lead by FLAA. The laboratory has a reporting limit of 0.0064% by wt., based upon a minimum sample weight of 0.25g submitted to the lab, and is not responsible for any result or reporting limit provided in mg/cm2 since it is dependent upon an area value provided by non-lab personnel. A "<" (less than) result signifies that the analyte was not detected at or above the reporting limit. Measurement of uncertainty and definitions of modifications are available upon request. Results in this report are not blank corrected unless specified.

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Cinnaminson, NJ 08077
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Lead (Pb) Chain of Custody

EMSL Order ID *(Lab Use Only)*: AE34979

RECEIVED EMSL CINNAMINSON, NJ 2026 SEP -1 A 11:37

Company : Element Environmental Solutions, Inc.		**EMSL-Bill to:** ☐ Different ☑ Same If Bill to is Different note instructions in Comments**	
Street: 61 Willow Street P.O. Box 921		*Third Party Billing requires written authorization from third party*	
City: Adamstown	**State/Province:** PA	**Zip/Postal Code:** 19501	**Country:** United States
Report To (Name): Dave Bertsch		**Telephone #:** 717-484-5111	
Email Address: IAQ@e2s.us		**Fax #:**	**Purchase Order:** 1041.0025
Project Name/~~Number~~: CRSD - Chancellor Center Admin		**Please Provide Results:** ☐ FAX ☑ E-mail ☐ Mail	
U.S. State Samples Taken: PA		**CT Samples:** ☐ **Commercial/Taxable** ☐ **Residential/Tax Exempt**	

Turnaround Time (TAT) Options* - Please Check

☐ 3 Hour ☐ 6 Hour ☐ 24 Hour ☐ 48 Hour [redacted] ☐ 96 Hour ☒ 1 Week ☐ 2 Week

**Analysis completed in accordance with EMSL's Terms and Conditions located in the Price Guide*

Matrix	Method	Instrument	Reporting Limit	Check
Chips ☒ % by wt. ☐ mg/cm² ☐ ppm	SW846-7000B	Flame Atomic Absorption	0.01%	☒
Air	NIOSH 7082	Flame Atomic Absorption	4 µg/filter	☐
	NIOSH 7105	Graphite Furnace AA	0.03 µg/filter	☐
	NIOSH 7300 modified	ICP-AES/ICP-MS	0.5 µg/filter	☐
Wipe* ASTM ☐ non ASTM ☐ *if no box is checked, non-ASTM Wipe is assumed	SW846-7000B	Flame Atomic Absorption	10 µg/wipe	☐
	SW846-6010B or C	ICP-AES	1.0 µg/wipe	☐
	SW846-7000B/7010	Graphite Furnace AA	0.075 µg/wipe	☐
TCLP	SW846-1311/7000B/SM 3111B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	SW846-1131/SW846-6010B or C	ICP-AES	0.1 mg/L (ppm)	☐
Soil	SW846-7000B	Flame Atomic Absorption	40 mg/kg (ppm)	☐
	SW846-7010	Graphite Furnace AA	0.3 mg/kg (ppm)	☐
	SW846-6010B or C	ICP-AES	2 mg/kg (ppm)	☐
Wastewater Unpreserved ☐ Preserved with HNO_3 pH < 2 ☐	SM3111B/SW846-7000B	Flame Atomic Absorption	0.4 mg/L (ppm)	☐
	EPA 200.9	Graphite Furnace AA	0.003 mg/L (ppm)	☐
	EPA 200.7	ICP-AES	0.020 mg/L (ppm)	☐
Drinking Water Unpreserved ☐ Preserved with HNO_3 pH < 2 ☐	EPA 200.9	Graphite Furnace AA	0.003 mg/L (ppm)	☐
	EPA 200.8	ICP-MS	0.001 mg/L (ppm)	☐
TSP/SPM Filter	40 CFR Part 50	ICP-AES	12 µg/filter	☐
	40 CFR Part 50	Graphite Furnace AA	3.6 µg/filter	☐
Other:				☐

Name of Sampler: Daniel Bertsch **Signature of Sampler:** [signature]

Sample #	Location / Component	~~Volume/Area~~	Date/~~Time~~ Sampled
CC-8/28-01PC	2002 Bldg - 2nd Floor Work Rm - Original Window Trim		8/28/26
-02PC	Throughout (Composite) - Plaster Walls / Ceilings		
-03PC	- Doors / Trim		
-04PC	- Interior Window Trim / Base boards		
-05PC	Exterior (composite) - Windows / Doors / Trim		

Client Sample #'s - **Total # of Samples:** 5

Relinquished (Client):	[signature]	**Date:**	8/31/26	**Time:**	p.m. Fed Ex
Received (Lab):	RSA EFX	**Date:**	9/1/26	**Time:**	12pm

Comments:

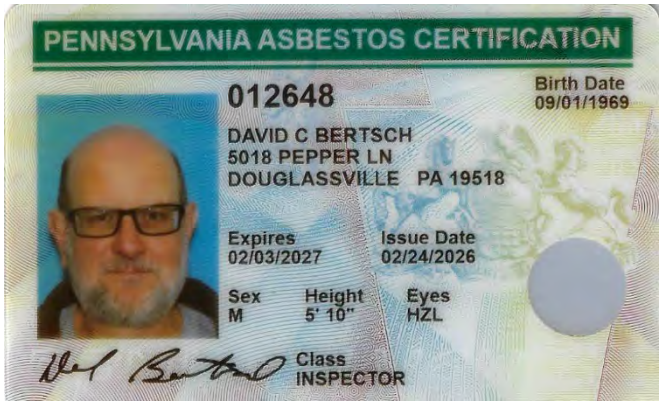
5 EC

Page 1 of 1 pages

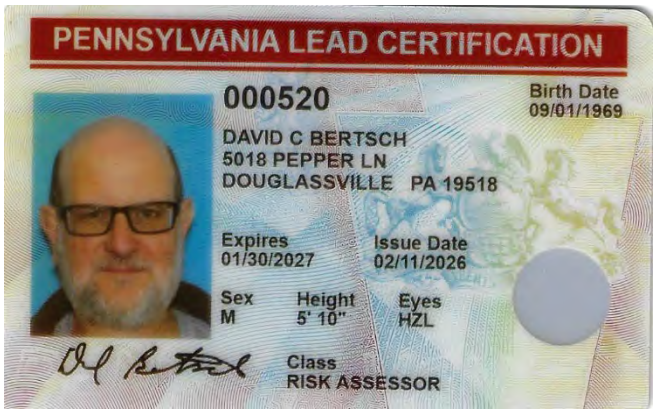
Appendix B

Accreditations

Asbestos Building Inspector Certifications



Lead Inspector/Risk Assessor Certification



Appendix C

Limited Asbestos Bulk Sampling (Above Ceiling) Report – Chancellor Center (June 12, 2026)

ELEMENT ENVIRONMENTAL
S O L U T I O N S

June 12, 2026

Jessica Binda-Rischow
Supervisor of Facilities/Physical Plant
Council Rock School District
30 N. Chancellor Street
Newtown, PA 18940

RE: Limited Asbestos Bulk Sampling (Above Ceiling)
Chancellor Center (Administration Building)
E2S Project 1041.0024 Task 6 – Subtask 14

Dear Jessica:

Element Environmental Solutions, Inc. (E2S) was contracted by the Council Rock School District to perform asbestos bulk sampling at The Chancellor Center (CRSD Administration Building), located at 30 N. Chancellor Street, Newtown, Pennsylvania, of suspect asbestos-containing materials (ACM) identified above select openings in the plaster ceilings, in support of the upcoming renovation project.

Summary

Bulk sampling was performed by Mr. David Bertsch of E2S on Wednesday, June 3, 2026. Mr. Bertsch is a certified Asbestos Building Inspector by the Environmental Protection Agency (EPA) and is licensed in the same capacity by the Pennsylvania Department of Labor and Industry (PaDLI). All samples were submitted to an accredited laboratory for analysis by Polarized Light Microscopy (PLM). The laboratory utilized for this project was: EMSL Analytical, Inc., located in Cinnaminson, New Jersey. EMSL is an American Industrial Hygiene Association (AIHA) and National Voluntary Laboratory Accreditation Program (NVLAP) accredited laboratory for asbestos PLM analysis. The bulk sample analysis results are summarized below and on Table 1.

Asbestos

The following suspect materials were identified above the existing plaster ceilings, sampled, and determined to contain asbestos at EPA-regulated levels (>1%):

- **Sound Insulation – Paper Wrap (White) – located above the ceilings between the joists**
- **Pipe Insulation (above plaster ceiling) – assumed above ceilings and inside walls throughout the building (inaccessible)**

The following suspect materials were identified, sampled, and determined NOT to contain asbestos at EPA-regulated levels (>1%):

- Ceiling Plaster – Base (Tan/Gray)* and Skim (White/Tan) Coats
- Sound Insulation (Brown/Tan/Black)

*Initial PLM analysis results for the base coat ceiling plaster samples (tan/gray) were all <1% asbestos, and were further analyzed via EPA 400 point count procedure, as recommended by EPA, to verify the results. Point Count results were all <0.25% asbestos (less than the detection limit for this type of analysis), confirming the materials are not defined as ACM (>1% asbestos, as defined by EPA).

Laboratory analytical reports with PLM and PLM Point Count asbestos bulk sample results from EMSL and accreditations (certifications and licenses) for E2S representatives are included with this report.

Thank you for the opportunity to present Element Environmental Solutions (E2S) as a partner in your environmental management efforts. Should you have questions or require additional information, please contact me.

Sincerely,
E2S, Inc.

David Bertsch
Operations Manager, IAQ

Table 1 - Asbestos Bulk Sample Analytical Results - Chancellor Center (Admin) - June 3, 2026

Sample Number	Location	Material Description	Analytical Result (PLM)
CC-6/3-01BK-Plaster	110E Auditorium (Board Room)	Ceiling Plaster - Base Coat (Tan)	*<0.25% Chrysotile**
CC-6/3-01BK-Skim Coat	110E Auditorium (Board Room)	Ceiling Plaster - Skim Coat (White)	None Detected
CC-6/3-02BK-Insulation	110E Auditorium (Board Room)	Sound Insulation - Above Ceiling (Brown/Tan/Black)	None Detected
CC-6/3-02BK-Wrap	**110E Auditorium (Board Room)**	**Sound Insulation Wrap - Above Ceiling (Tan/White)**	**25% Chrysotile**
CC-6/3-03BK-Plaster	W. Hallway o/s 190W	Ceiling Plaster - Base Coat (Tan)	*<0.25% Chrysotile**
CC-6/3-03BK-Skim Coat	W. Hallway o/s 190W	Ceiling Plaster - Skim Coat (White)	None Detected
CC-6/3-03BK-Skim Coat 2	W. Hallway o/s 190W	Ceiling Plaster - Skim Coat 2 (Tan)	None Detected
CC-6/3-04BK	**W. Hallway o/s 190W**	**Pipe Insulation (Above Ceiling)**	**30% Chrysotile**
CC-6/3-05BK-Plaster	W. Hallway o/s 153W (Copy Rm)	Ceiling Plaster - Base Coat (Gray)	*<0.25% Chrysotile**
CC-6/3-05BK-Skim Coat	W. Hallway o/s 153W (Copy Rm)	Ceiling Plaster - Skim Coat (White)	None Detected
CC-6/3-06BK-Insulation	W. Hallway o/s 153W (Copy Rm)	Sound Insulation - Above Ceiling (Brown)	None Detected
CC-6/3-06BK-Wrap	**W. Hallway o/s 153W (Copy Rm)**	**Sound Insulation Wrap - Above Ceiling (Brown/White)**	**35% Chrysotile**

**Analyzed via EPA 400 PLM Point Count procedure, less than detection limit and EPA definition of an asbestos-containing material (>1% is defined as ACM)*

EMSL Analytical, Inc.

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Phone/Fax: (800) 220-3675 / (856) 786-5974
http://www.EMSL.com / cinnasblab@EMSL.com

EMSL Order ID:	042611065
Customer ID:	ELES42
Customer PO:	1041.0024 T6
Project ID:	

Attn:	David Bertsch Element Environmental Solutions, Inc. 61 Willow Street PO Box 921 Adamstown, PA 19501	Phone: Fax: Collected: Received: Analyzed:	(717) 484-5111 6/ 3/2026 6/04/2026 6/10/2026
Proj:	CRSD - Chancellor		

Summary Test Report for Asbestos Analysis of Bulk Material

Client Sample ID: CC-6/3-01BK-Plaster ***Lab Sample ID:*** **042611065-0001**

Sample Description: 110E Auditorium (Board Rm)/Ceiling Plaster

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	6/05/2026	Tan	2.0%	98.0%	**<1% Chrysotile**	
400 PLM Pt Ct	6/10/2026	Tan	0.0%	100.0%	**<0.25% Chrysotile**	

Client Sample ID: CC-6/3-01BK-Skim Coat ***Lab Sample ID:*** **042611065-0001A**

Sample Description: 110E Auditorium (Board Rm)/Ceiling Skim Coat

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	6/05/2026	White	0.0%	100.0%	None Detected	

Client Sample ID: CC-6/3-02BK-Insulation ***Lab Sample ID:*** **042611065-0002**

Sample Description: 110E Auditorium (Board Rm)/Sound Insulation (Above Ceiling)

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	6/05/2026	Brown/Tan/Black	90.0%	10.0%	None Detected	

Client Sample ID: CC-6/3-02BK-Wrap ***Lab Sample ID:*** **042611065-0002A**

Sample Description: 110E Auditorium (Board Rm)/Sound Insulation (Above Ceiling)

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	6/05/2026	Tan/White	60.0%	15.0%	**25% Chrysotile**	

Client Sample ID: CC-6/3-03BK-Plaster ***Lab Sample ID:*** **042611065-0003**

Sample Description: W. Hallway O/S 190W/Ceiling Plaster

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	6/05/2026	Tan	2.0%	98.0%	**<1% Chrysotile**	
400 PLM Pt Ct	6/10/2026	Tan	0.0%	100.0%	**<0.25% Chrysotile**	

Client Sample ID: CC-6/3-03BK-Skim Coat ***Lab Sample ID:*** **042611065-0003A**

Sample Description: W. Hallway O/S 190W/Ceiling Skim Coat

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	6/05/2026	White	0.0%	100.0%	None Detected	

Client Sample ID: CC-6/3-03BK-Skim Coat 2 ***Lab Sample ID:*** **042611065-0003B**

Sample Description: W. Hallway O/S 190W/Ceiling Skim Coat

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	6/05/2026	Tan	0.0%	100.0%	None Detected	

EMSL Analytical, Inc.

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Phone/Fax: (800) 220-3675 / (856) 786-5974
http://www.EMSL.com / cinnasblab@EMSL.com

EMSL Order ID:	042611065
Customer ID:	ELES42
Customer PO:	1041.0024 T6
Project ID:	

Summary Test Report for Asbestos Analysis of Bulk Material

Client Sample ID: CC-6/3-04BK ***Lab Sample ID:*** **042611065-0004**

Sample Description: W. Hallway O/S 190W/Pipe Insulation (Above Ceiling)

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	6/05/2026	Tan	30.0%	40.0%	**30% Chrysotile**	

Client Sample ID: CC-6/3-05BK-Plaster ***Lab Sample ID:*** **042611065-0005**

Sample Description: W. Hallway O/S 153W (Copy Rm)/Ceiling Plaster

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	6/08/2026	Gray	3.0%	97.0%	**<1% Chrysotile**	
400 PLM Pt Ct	6/10/2026	Gray	0.0%	100.0%	**<0.25% Chrysotile**	

Client Sample ID: CC-6/3-05BK-Skim Coat ***Lab Sample ID:*** **042611065-0005A**

Sample Description: W. Hallway O/S 153W (Copy Rm)/Ceiling Skim Coat

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	6/08/2026	White	0.0%	100.0%	None Detected	

Client Sample ID: CC-6/3-06BK-Insulation ***Lab Sample ID:*** **042611065-0006**

Sample Description: W. Hallway O/S 153W (Copy Rm)/Sound Insulation (Above Ceiling)

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	6/08/2026	Brown	90.0%	10.0%	None Detected	

Client Sample ID: CC-6/3-06BK-Wrap ***Lab Sample ID:*** **042611065-0006A**

Sample Description: W. Hallway O/S 153W (Copy Rm)/Sound Insulation (Above Ceiling)

TEST	Analyzed Date	Color	Non-Asbestos Fibrous	Non-Asbestos Non-Fibrous	Asbestos	Comment
PLM	6/08/2026	Brown/White	60.0%	5.0%	**35% Chrysotile**	

EMSL Analytical, Inc.
200 Route 130 North Cinnaminson, NJ 08077
Phone/Fax: (800) 220-3675 / (856) 786-5974
http://www.EMSL.com / cinnasblab@EMSL.com

EMSL Order ID:	042611065
Customer ID:	ELES42
Customer PO:	1041.0024 T6
Project ID:	

Summary Test Report for Asbestos Analysis of Bulk Material

Analyst(s):

Andrea Doughty	PLM (4)
Kiara Secula	400 PLM Pt Ct (3)
Russell Hayden	PLM (8)

Reviewed and approved by:

Samantha Sweeney

Samantha Sweeney, Laboratory Manager
or Other Approved Signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This is a summary report; official reports are available on LabConnect or upon request and relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. The above analyses were performed in general compliance with Appendix E to Subpart E of 40 CFR (previously EPA 600/M4-82-020 "Interim Method") but augmented with procedures outlined in the 1993 ("final") version of the method. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Estimation of uncertainty is available on request.

Samples analyzed by EMSL Analytical, Inc. Cinnaminson, NJ NVLAP Lab Code 101048-0, AIHA LAP, LLC-IHLAP Lab 100194, PA ID# 68-00367, LA #04127

Report amended: 06/10/202611:32:00 Replaces initial report from: 06/08/202612:59:04 Reason Code: Client-Additional Analysis

OrderID: 042611065

EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

Asbestos Bulk Building Material Chain of Custody

EMSL Order Number *(Lab Use Only)*: 042611065

EMSL Analytical, Inc.
200 Route 130 North
Cinnaminson, NJ 08077
PHONE: 1-800-220-3675
FAX: (856) 786-5974

Company : Element Environmental Solutions	**EMSL-Bill to:** ☑ Same ☐ Different If Bill to is Different note instructions in Comments** *Third Party Billing requires written authorization from third party*
Street: 61 Willow Street PO Box 921	
City: Adamstown **State/Province:** PA	**Zip/Postal Code:** 19501 **Country:** United States
Report To (Name): David Bertsch	**Telephone #:** 717-484-5111
Email Address: IAQ@e2s.us	**Fax #:** **Purchase Order:** 1041.0024
Project Name/~~Number~~: CRSD - Chancellor Center (Admin)	**Please Provide Results:** ☐ Fax ☑ Email ☐ Mail
U.S. State Samples Taken: PA	**CT Samples:** ☐ Commercial/Taxable ☐ Residential/Tax Exempt

Turnaround Time (TAT) Options* – Please Check

☐ 3 Hour ☐ 6 Hour ☐ 24 Hour ☑ 48 Hour ☐ 72 Hour ☐ 96 Hour ☐ 1 Week ☐ 2 Week

*For TEM Air 3 hr through 6 hr, please call ahead to schedule. *There is a premium charge for 3 Hour TEM AHERA or EPA Level II TAT. You will be asked to sign an authorization form for this service. Analysis completed in accordance with EMSL's Terms and Conditions located in the Analytical Price Guide.

PLM - Bulk (reporting limit)	TEM – Bulk
☑ PLM EPA 600/R-93/116 (<1%)	☐ TEM EPA NOB – EPA 600/R-93/116 Section 2.5.5.1
☐ PLM EPA NOB (<1%)	☐ NY ELAP Method 198.4 (TEM)
Point Count ☐ 400 (<0.25%) ☐ 1000 (<0.1%)	☐ Chatfield Protocol (semi-quantitative)
Point Count w/Gravimetric ☐ 400 (<0.25%) ☐ 1000 (<0.1%)	☐ TEM % by Mass – EPA 600/R-93/116 Section 2.5.5.2
☐ NIOSH 9002 (<1%)	☐ TEM Qualitative via Filtration Prep Technique
☐ NY ELAP Method 198.1 (friable in NY)	☐ TEM Qualitative via Drop Mount Prep Technique
☐ NY ELAP Method 198.6 NOB (non-friable-NY)	**Other**
☐ OSHA ID-191 Modified	☐
☐ Standard Addition Method	

RECEIVED EMSL CINNAMINSON, NJ 2026 JUN -4 AM 8:

☐ **Check For Positive Stop – Clearly Identify Homogenous Group** **Date Sampled:** 6-3-26

Samplers Name: David Bertsch **Samplers Signature:** [signature]

Sample #	HA #	Sample Location	Material Description
CC-6	3-01BK	110E Auditorium (Board Rm)	Ceiling Plaster
-	-02BK	↓ ↓ ↓	Sound Insulation (Above Ceiling)
-	-03BK	W. Hallway o/s 190W	Ceiling Plaster
-	-04BK	↓ ↓	Pipe Insulation (Above Ceiling)
-	-05BK	W. Hallway o/s 153W (Copy Rm)	Ceiling Plaster
-	-06BK	↓ ↓ ↓	Sound Insulation (Above Ceiling)

Client Sample # (s): - **Total # of Samples:** 6

Relinquished (Client): [signature] **Date:** 6/3/26 **Time:** Fed-Ex drop box

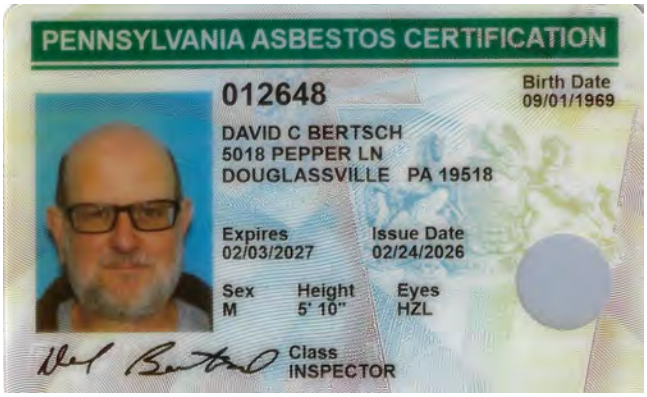
Received (Lab): Angie O'Neill EFY **Date:** 6/4/26 **Time:** 0920

Comments/Special Instructions:

Page 1 of 1 pages

6JAC

Asbestos Building Inspector Certification
David Bertsch - Expiration 02/03/2027



ELEMENT ENVIRONMENTAL
S O L U T I O N S

October 9, 2026

Jessica Binda-Rischow
Supervisor of Facilities/Physical Plant
Council Rock School District
30 N. Chancellor Street
Newtown, PA 18940

RE: Asbestos Bulk Sampling (Attic Spaces)
Chancellor Center (Administration Building)
E2S Project 1041.0025

Dear Jessica:

Element Environmental Solutions, Inc. (E2S) performed asbestos bulk sampling at The Chancellor Center (CRSD Administration Building), located at 30 N. Chancellor Street, Newtown, Pennsylvania, of suspect asbestos-containing materials (ACM) located in the 1871 and 1918 attic spaces, in support of the upcoming renovation project, as a follow-up to the initial hazardous materials investigations.

Summary

Bulk sampling was performed by Mr. David Bertsch of E2S on Wednesday, September 30, 2026. Mr. Bertsch is a certified Asbestos Building Inspector by the Environmental Protection Agency (EPA) and is licensed in the same capacity by the Pennsylvania Department of Labor and Industry (PaDLI). All samples were submitted to an accredited laboratory for analysis by Polarized Light Microscopy (PLM). The laboratory utilized for this project was: EMSL Analytical, Inc., located in Cinnaminson, New Jersey. EMSL is an American Industrial Hygiene Association (AIHA) and National Voluntary Laboratory Accreditation Program (NVLAP) accredited laboratory for asbestos PLM analysis. The bulk sample analysis results are summarized below and on Table 1.

Asbestos

The following suspect materials were identified in the attic spaces, sampled, and determined to contain asbestos at EPA-regulated levels (>1%):

- None

The following suspect materials were identified, sampled, and determined NOT to contain asbestos at EPA-regulated levels (>1%):

- Tar-Like HVAC Pipe Wrap (Black) – 1871 and 1918 Attic Spaces
- Blown-in Insulation (White/Yellow) – 1871 and 1918 Attic Spaces
- Plaster between Wood Lathe (2nd Floor Ceilings) – 1817 and 1918 Attic Spaces
- Drywall/Gypsum below Plaster (2nd Floor Ceilings) – 1817 Attic Space

Laboratory analytical reports with PLM asbestos bulk sample results from EMSL and accreditations (certifications and licenses) for E2S representatives are included with this report.

Thank you for the opportunity to present Element Environmental Solutions (E2S) as a partner in your environmental management efforts. Should you have questions or require additional information, please contact me.

Sincerely,
E2S, Inc.

David Bertsch
Operations Manager, IAQ

Table 1 - Asbestos Bulk Sample Analytical Results - Chancellor Center (Admin) Attic Spaces - September 30, 2026

Sample Number	Location	Material Description	Analytical Result (PLM)
CC-9/30-01BK	1918 Attic Space	Tar-Like HVAC Pipe Wrap (Black)	None Detected
CC-9/30-02BK	1918 Attic Space	Blown-in Insulation (White/Yellow)	None Detected
CC-9/30-03BK	1918 Attic Space	Plaster Between Wood Lathe (Gray/Yellow)	*<1% Chrysotile*
CC-9/30-04BK	1871 Attic Space	Tar-Like HVAC Pipe Wrap (Black)	None Detected
CC-9/30-05BK	1871 Attic Space	Blown-in Insulation (White)	None Detected
CC-9/30-06BK	1871 Attic Space	Plaster Between Wood Lathe (Gray)	*<1% Chrysotile*
CC-9/30-07BK	1871 Attic Space	Drywall/Gypsum Below Plaster (2nd Floor Ceiling)	None Detected

EMSL Analytical, Inc.

200 Route 130 North Cinnaminson, NJ 08077

Tel/Fax: (800) 220-3675 / (856) 786-5974

http://www.EMSL.com / cinnasblab@EMSL.com

EMSL Order:	042621130
Customer ID:	ELES42
Customer PO:	1041.0025
Project ID:	

Attention:	David Bertsch	**Phone:**	(717) 484-5111
	Element Environmental Solutions, Inc.	**Fax:**	
	61 Willow Street	**Received Date:**	10/06/2026 9:50 AM
	PO Box 921	**Analysis Date:**	10/07/2026
	Adamstown, PA 19501	**Collected Date:**	09/30/2026
Project:	CRSD - Chancellor Center Admin - Attics		

Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
CC-9/30-01BK *042621130-0001*	1918 Attic Space - Tar Like HVAC Pipe Wrap	Black Non-Fibrous Homogeneous		10% Ca Carbonate 90% Non-fibrous (Other)	None Detected
CC-9/30-02BK *042621130-0002*	1918 Attic Space - Blow-in Insulatioon	White/Yellow Fibrous Homogeneous	5% Cellulose 85% Glass	10% Non-fibrous (Other)	None Detected
CC-9/30-03BK *042621130-0003*	1918 Attic Space - Plaster between Wood Lathe	Gray/Yellow Fibrous Homogeneous	3% Cellulose	45% Quartz 52% Non-fibrous (Other)	**<1% Chrysotile**
CC-9/30-04BK *042621130-0004*	1871 Attic Space - Tar Like HVAC Pipe Wrap	Black Non-Fibrous Homogeneous		10% Ca Carbonate 90% Non-fibrous (Other)	None Detected
CC-9/30-05BK *042621130-0005*	1871 Attic Space - Blow-in Insulatioon	White Fibrous Homogeneous	95% Min. Wool	5% Non-fibrous (Other)	None Detected
CC-9/30-06BK *042621130-0006*	1871 Attic Space - Plaster between Wood Lathe	Gray Fibrous Homogeneous	2% Cellulose	30% Quartz 68% Non-fibrous (Other)	**<1% Chrysotile**
CC-9/30-07BK *042621130-0007*	1871 Attic Space - Drywall below Plaster	Brown/White Fibrous Homogeneous	15% Cellulose 8% Glass	50% Gypsum 27% Non-fibrous (Other)	None Detected

Analyst(s)

Brett Teixeira (3)

Jannat Fareen (4)

Samantha Sweeney

Samantha Sweeney, Laboratory Manager
or Other Approved Signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. The above analyses were performed in general compliance with Appendix E to Subpart E of 40 CFR (previously EPA 600/M4-82-020 "Interim Method") but augmented with procedures outlined in the 1993 ("final") version of the method. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Estimation of uncertainty is available on request.

Samples analyzed by EMSL Analytical, Inc. Cinnaminson, NJ NVLAP Lab Code 101048-0, AIHA LAP, LLC-IHLAP Lab 100194, PA ID# 68-00367, LA #04127

Initial report from: 10/07/2026 12:22:49

OrderID: 042621130

EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

Asbestos Bulk Building Material Chain of Custody

EMSL Order Number (*Lab Use Only*): 042621130

EMSL Analytical, Inc.
200 Route 130 North
Cinnaminson, NJ 08077
PHONE: 1-800-220-3675
FAX: (856) 786-5974

Company: Element Environmental Solutions	**EMSL-Bill to:** ☑ Same ☐ Different If Bill to is Different note instructions in Comments** *Third Party Billing requires written authorization from third party*
Street: 61 Willow Street PO Box 921	
City: Adamstown **State/Province:** PA	**Zip/Postal Code:** 19501 **Country:** United States
Report To (Name): David Bertsch	**Telephone #:** 717-484-5111
Email Address: IAQ@e2s.us	**Fax #:** **Purchase Order:** 1041.0025
Project Name/~~Number:~~ CRSD - Chancellor Center Admin - Attics	**Please Provide Results:** ☐ Fax ☑ Email ☐ Mail
U.S. State Samples Taken: PA	**CT Samples:** ☐ Commercial/Taxable ☐ Residential/Tax Exempt

Turnaround Time (TAT) Options* – Please Check

☐ 3 Hour ☐ 6 Hour ☒ 24 Hour ~~☐ 48 Hour~~ ☐ 72 Hour ☐ 96 Hour ☐ 1 Week ☐ 2 Week

*For TEM Air 3 hr through 6 hr, please call ahead to schedule. There is a premium charge for 3 Hour TEM AHERA or EPA Level II TAT. You will be asked to sign an authorization form for this service. Analysis completed in accordance with EMSL's Terms and Conditions located in the Analytical Price Guide.

PLM - Bulk (reporting limit)	TEM – Bulk
☒ PLM EPA 600/R-93/116 (<1%)	☐ TEM EPA NOB – EPA 600/R-93/116 Section 2.5.5.1
☐ PLM EPA NOB (<1%)	☐ NY ELAP Method 198.4 (TEM)
Point Count ☐ 400 (<0.25%) ☐ 1000 (<0.1%)	☐ Chatfield Protocol (semi-quantitative)
Point Count w/Gravimetric ☐ 400 (<0.25%) ☐ 1000 (<0.1%)	☐ TEM % by Mass – EPA 600/R-93/116 Section 2.5.5.2
☐ NIOSH 9002 (<1%)	☐ TEM Qualitative via Filtration Prep Technique
☐ NY ELAP Method 198.1 (friable in NY)	☐ TEM Qualitative via Drop Mount Prep Technique
☐ NY ELAP Method 198.6 NOB (non-friable-NY)	**Other**
☐ OSHA ID-191 Modified	☐
☐ Standard Addition Method	

RECEIVED EMSL CINNAMINSON, NJ 2026 OCT -6 P 12:27

☐ **Check For Positive Stop – Clearly Identify Homogenous Group** **Date Sampled:**

Samplers Name: David Bertsch **Samplers Signature:** D Bertsch

Sample #	HA #	Sample Location	Material Description
CC-9/30	-01BK	1918 Attic Space	Tar-like HVAC Pipe wrap
"	-02BK		Blown-in Insulation
"	-03BK		Plaster Between wood lathe
"	-04BK	1871 Attic Space	Tar-like HVAC Pipe wrap
"	-05BK		Blown-in Insulation
"	-06BK		Plaster Between wood Lathe
"	-07BK		Drywall Below Plaster

Client Sample # (s): **Total # of Samples:** 7

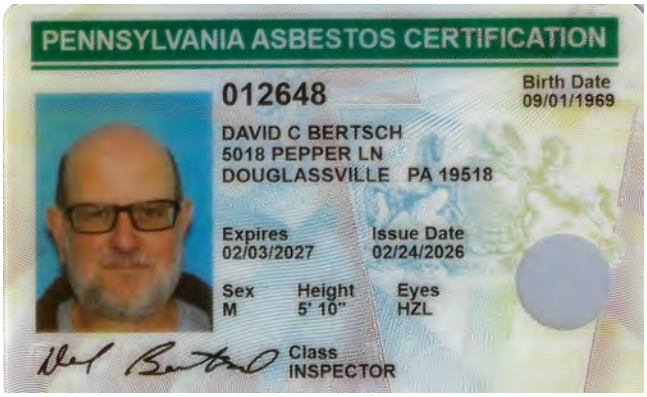
Relinquished (Client): D Bertsch **Date:** 10/5/26 **Time:** P.M. Fed-Ex

Received (Lab): Nerthil T. EFx **Date:** 10/06/26 **Time:** 9:50am

Comments/Special Instructions:

Page 1 of 1 pages

Asbestos Building Inspector Certification
David Bertsch - Expiration 02/03/2027



SECTION 020900

SUMMARY OF WORK – ASBESTOS ABATEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections apply to this Section. Asbestos Abatement – Summary of Work was prepared by Element Environmental Solutions, Inc. (E2S), by a Pennsylvania Licensed Asbestos Project Designer (#012648), under E2S Project 1041.0025.

1.2 SUMMARY

A. Section Includes:

Technical specifications for:

1. Removal and disposal of asbestos-containing materials (ACM) at the Council Rock School District – Chancellor Center, as detailed below.
2. Refer to Abatement Drawings ASB-01 through ASB-03 for representative locations of asbestos-containing materials (ACM) included in the Abatement Contract, including project notes.
3. Reference all other project drawings included with the Bid Documents for coordination between abatement, demolition, new construction, etc., as applicable.

1.3 SEPARATE CONTRACTS

Renovations to the existing Chancellor Center

1.4 PERFORMANCE REQUIREMENTS

A. Coordinate abatement activities under the work of this contract with the Construction Manager, Architect, Environmental Consultant, and the Owner at project meetings prior to the start of construction, as applicable, and within agreed upon timeframes; and throughout the project.

B. Work shall be performed in accordance with these specifications, including all codes, regulations, and requirements pertaining to the work detailed below in Scope of Work.

1.5 GENERAL REQUIREMENTS

A. Any Contractor performing asbestos abatement activities must be licensed as an asbestos abatement contractor by the Pennsylvania Department of Labor and Industry (PA DLI), and shall provide documentation prior to starting work.

B. Asbestos Abatement Workers and Supervisors must also be licensed as such by PA DLI and have current licenses on-site at all times. An Asbestos Supervisor must be on site at all times during abatement activities.

C. Abatement Contractor will be responsible for preparing and submitting proper notifications to governing agencies including EPA, DEP, and PA DLI as applicable, in a timely manner sufficient to be able to perform the work without delaying the project.

D. Abatement Contractor will be responsible for means and methods necessary to access and remove all asbestos-containing materials (ACM).

E. All abatement activities, removal procedures, etc. will be performed in strict accordance with the most stringent governing regulations that apply, including but not limited to the following:

- PA DLI – Accreditation and Licensing Acts
- EPA's AHERA and NESHAP's Regulations
- OSHA's Asbestos and Lead in Construction Standards
- All other federal, state and local regulations that apply

Where a conflict arises between specifications and regulations, the most stringent takes precedence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 ASBESTOS ABATEMENT – SCOPE OF WORK

A. <u>Base Bid</u>

<u>Ground Floor</u>

1. Removal and proper disposal of five (5) existing exterior window systems (including trim, stools and apron) associated with the 1894 Building, in their entirety, and <u>all</u> associated asbestos-containing window caulk and glazing, as indicated on Drawing ASB-01. Abatement Contractor will coordinate all exterior work (window removal), sequencing, and schedules with the General Contractor and will complete demolition and abatement in a timely manner to allow for construction and installation of new windows. The General Contractor will provide temporary enclosures for the window openings, upon completion of abatement/demo.

See Drawing No. ASB-01 for the representative locations of the windows included in the abatement contract for removal and disposal. See Removal Procedures – Asbestos below, for details on removal and disposal requirements.

<u>First Floor</u>

1. Removal and proper disposal of approximately 6,350 S.F. of non-ACM plaster ceilings and associated soundproofing insulation (ACM paper wrap and non-ACM insulation), located above the plaster ceilings between the existing wood joists, in the 1871 and 1918 Buildings.

See Drawing ASB-02 for representative locations of non-ACM plaster ceilings and ACM soundproofing insulation included in the abatement scope of work. See Removal Procedures – Asbestos below, for details on removal and disposal requirements. Coordination may be required with the Demolition/Mechanical Contractor regarding the duct troughs (scheduled for demolition) that are attached to, or in the vicinity of, the existing plaster ceilings, in certain locations.

2. Removal and proper disposal of approximately 5 L.F. of asbestos-containing pipe insulation located above the plaster ceiling in the 1932 Building (minor demolition required to access). Additional ACM pipe and/or fitting insulation located above hard ceilings or inside walls (inaccessible), if identified during demo, will be handled under unit prices/allowances.

   See Drawing No. ASB-02 for the representative location of identified ACM pipe insulation included in the abatement scope of work. See Removal Procedures – Asbestos below, for details on removal and disposal requirements.

3. Removal and proper disposal of two (2) existing interior window systems (including trim, stools and apron) associated with the 1871/2002 Buildings (original exterior of the 1871 Building, now part of the 2002 Addition - Lobby), in their entirety, and all associated asbestos-containing window caulk and glazing, as indicated on Drawing ASB-02.

   See Drawing No. ASB-02 for the representative locations of the windows included in the abatement contract for removal and disposal. See Removal Procedures – Asbestos below, for details on removal and disposal requirements.

4. Removal and proper disposal of existing built-in chalkboards and associated trim, and associated adhesive (assumed ACM – if present) located throughout the First Floor, as indicated on Drawing ASB-02.

   See Drawing No. ASB-02 for the representative locations of the chalkboards and adhesive included in the abatement contract for removal and disposal. See Removal Procedures – Asbestos below, for details on removal and disposal requirements.

Second Floor

1. Removal and proper disposal of two (2) existing interior window systems (including trim, stools and apron) associated with the 1871/2002 Buildings (original exterior of the 1871 Building, now part of the 2002 Addition – Work Room), in their entirety, and all associated asbestos-containing window caulk and glazing, as indicated on Drawing ASB-03.

   See Drawing No. ASB-03 for the representative locations of the windows included in the abatement contract for removal and disposal. See Removal Procedures – Asbestos below, for details on removal and disposal requirements.

2. Removal and proper disposal of existing built-in chalkboards and associated trim, and associated adhesive (assumed ACM – if present) located throughout the Second Floor, as indicated on Drawing ASB-03.

   See Drawing No. ASB-03 for the representative locations of the chalkboards and adhesive included in the abatement contract for removal and disposal. See Removal Procedures – Asbestos below, for details on removal and disposal requirements

   Quantities provided are estimated; Contractor to field verify site conditions and quantities prior to bidding and is responsible for the removal and disposal of all materials identified on the drawings.

B. Alternate Bids

There are NO Alternate Bids included in the Abatement Contract.

C. Unit Prices/Allowances

See Bid Form for Asbestos Abatement (Bid Package #5 – Abatement Construction) for allowances and unit prices that are included in the Base Bid for Asbestos Abatement.

D. Schedule

Reference the overall project schedule included in the Bid Documents, for project phasing and durations. Abatement Contractor shall coordinate all abatement, including scheduling and sequencing, with the Owner, Construction Manager, Architect, Environmental Consultant, and all trades. Abatement Contractor will complete abatement in a timely manner to allow for the start of construction in each area. Actual start dates are tentative and are subject to change; if necessary, coordination may be required to adjust the schedule accordingly. Contractor shall provide sufficient manpower to meet contract schedules and shall coordinate abatement with the other trades, as needed, for scheduling and sequencing of work, including any required demolition prior to abatement.

E. REMOVAL PROCEDURES - ASBESTOS

ACM Soundproofing Insulation (Above Plaster Ceiling)

Contractor shall perform the removal of non-ACM ceiling plaster and asbestos-containing soundproofing insulation located above plaster ceilings (between wood joists) under full containment with a 3-stage decontamination chamber in place, under negative pressure, using wet removal methods. Full containment shall consist of 2-layers of 6-mil polyethylene sheeting for critical barriers, 2-layers of 6-mil poly sheeting on walls, and 2-layers of 6-mil poly sheeting on floors. Contractor shall erect proper signage to meet OSHA regulated area requirements.

Contractor shall remove non-ACM plaster ceilings in their entirety, down to existing wood joists, via demolition methods, to access and remove ACM soundproofing that is located above the plaster ceiling between existing wood joists (joists are 16” on center). Soundproofing insulation shall be removed in its entirety, including the ACM paper wrap and associated non-ACM “horsehair” insulation. In locations where electrical/mechanical devices or components are attached to the ceilings (i.e., diffusers, lights, speakers, fire alarms, etc.), Abatement Contractor shall temporarily support devices and leave them in place. Contractor shall NOT begin demolition of existing plaster ceilings until critical barriers are in place and a negative pressure regulated area has been established in case ACM debris exists above the ceiling. If existing ACM debris is identified on ceilings, the debris and contaminated ceiling shall be removed and disposed of as friable asbestos; otherwise, uncontaminated ceilings may be disposed of as demolition debris.

Quantities provided are based on wall-to-wall calculations. Prior to any work involving demolition of the existing plaster ceilings, abatement contractor to work with both the General and Mechanical contractors to coordinate the shut-down of HVAC equipment, etc. feeding the work areas, prior to ceiling demolition and subsequent abatement.

Upon completion of the gross removal, Contractor shall remove wall and floor poly, where present, (critical barriers left in place) and fine clean the entire work area, including remaining ceiling substrates and exposed components, so it is free of ACM debris. Upon completion of removal and visual inspection, Contractor shall encapsulate the work area. ACM soundproofing must be disposed of as Friable Asbestos in an EPA-approved asbestos landfill. All waste shall be properly packaged and labeled, and manifested, according to regulation for the type of materials.

ACM Pipe Insulation/Fitting Insulation

Contractor shall perform the removal of asbestos-containing pipe/fitting insulation with critical barriers and a 3-stage decontamination chamber in place (where applicable based on quantity of ACM to meet OSHA requirements), under negative pressure, using wet removal methods, and using glove-bag removal techniques in accordance with regulations. Critical barriers shall consist of 2 layers of 6-mil polyethylene sheeting, and Contractor shall erect proper signage to meet OSHA regulated area requirements. Contractor shall place a 6-mil "drop cloth" beneath piping in all locations of glove-bag removal and shall operate a HEPA-vacuum in conjunction with the glove-bag removal process. When removing ACM fitting insulation, Contractor shall remove fiberglass pipe insulation at least 2" back from the ACM fitting insulation, as a buffer zone.

The identified ACM pipe insulation is located above a plaster ceiling requiring demolition to access (abatement contractor to provide the minor demolition to access). For ACM pipe/fitting insulation inside walls or above hard ceilings that may be uncovered during demolition, once accessible based upon scope of selective demo, actual quantities of ACM pipe/fitting insulation will be verified at that time, and handled accordingly using unit prices and quantity allowances.

Upon completion of removal and visual inspection, Contractor shall apply an approved encapsulant to the pipe substrate. ACM pipe/fitting insulation must be disposed of as Friable Asbestos in an EPA-approved asbestos landfill. All waste shall be properly packaged and labeled, and manifested, according to regulation for the type of materials

Chalkboards and Associated Adhesive

Contractor shall perform the removal of built-in chalkboards/trim and associated assumed asbestos-containing adhesive (if present) inside of a tent enclosure, with a 1-stage decontamination chamber in place, under negative pressure, and using wet removal methods. Tent enclosure shall be constructed of 1 layer of 6-mil polyethylene sheeting for walls, ceiling, and floor. Contractor shall erect proper signage to meet OSHA regulated area requirements. **If the chalkboards are located in an abatement work area already under full containment (see ACM soundproofing above), the construction of tent enclosures is not necessary.**

Since the building is scheduled for renovation and NOT demolition, Contractor shall take care when removing the adhesive so as to not significantly damage the existing substrate; General Contractor (GC) is to the patch resulting wall finish, as needed. All materials, if not rendered friable, may be disposed of as Category I Non-Friable Asbestos Waste in a landfill that accepts such material. All waste shall be properly packaged and labeled, and manifested, according to regulation for the type of materials.

Interior ACM Window Caulk/Glazing (Window System Removal)

Contractor shall perform the removal and disposal of the select window systems, and associated asbestos-containing interior window caulk and glazing, inside of a tent enclosure, with a 1-stage decontamination chamber in place, under negative pressure, and using wet removal methods. Tent enclosure shall be constructed of 1 layer of 6-mil polyethylene sheeting for walls, ceiling, and floor. Contractor shall erect proper signage to meet OSHA regulated area requirements. **If the window systems are located in an abatement work area already under full containment (see ACM soundproofing above), the construction of tent enclosures is not necessary**.

Scope of work involving the interior window systems includes removal and disposal or salvage of the entire window assembly, including trim, stools, and aprons, and all associated asbestos-containing caulk and glazing, intact. Removal process for caulking that remains adhered to the interior walls (if applicable) shall consist of manual scraping, using wet and non-friable removal methods, to remove the caulking from the building substrate.

Window systems shall be placed in an approved waste container for proper transportation and disposal to the landfill. Waste Container shall be covered and locked at all times the Contractor is not on site, to prevent access to the public. Upon completion of the removal, Contractor shall visually inspect the work area for possible ACM debris. **Contractor shall leave the site clean and free of ACM debris.**

Exterior ACM Window Caulk/Glazing (Window System Removal)

Contractor shall perform the removal and disposal of the select window systems, and associated asbestos-containing exterior window caulk and glazing, using wet removal methods and non-friable removal techniques. Contractor shall begin by covering the ground in the immediate areas of removal with one (1) layer of 6-mil poly sheeting, secured at least ten (10) feet in all directions, wherever feasible, or at a sufficient distance to contain potential debris, to act as a drop cloth and contain any debris that may fall during the removal process. Contractor shall also seal all openings to inside the building (i.e. exhaust duct, penetrations, etc.) and seal the windows inside the building in the locations where windows are removed (attach to walls on each side of window prior to removal), using 6-mil poly sheeting as a critical barrier, to prevent potential fiber release inside the building. Appropriate OSHA warning signs, barrier tape, etc. shall be posted at the access points to the work area, to prevent entry by unauthorized personnel.

Scope of work involving the exterior window systems includes removal and disposal or salvage of the entire window assembly, including trim, stools, and aprons, and all associated asbestos-containing caulk and glazing, intact. Removal of exterior ACM shall be performed, at a minimum, in accordance with the Environmental Protection Agency (EPA) National Emissions Standard for Hazardous Air Pollutants (NESHAP's) regulation, which requires non-friable, wet removal techniques with no visible emissions; and the Occupational Safety and Health Administration (OSHA) Asbestos Construction Standard, which regulates work practices and employee protection during asbestos removal projects. Removal shall be performed using work practices that prevent the caulk/glazing from becoming friable, including wet-misting techniques and operating a high-efficiency particulate air (HEPA) vacuum in the immediate vicinity of the removal. The use of tools or operations that may sand, grind, or abrade, or otherwise render the materials friable, are not allowed. Removal process for caulking that remains adhered to the building (if applicable) shall consist of manual scraping, using wet and non-friable removal methods, to remove the caulking from the building substrate.

Window systems shall be safely lowered (not thrown or dropped) to the ground upon removal and placed in an approved waste container for proper transportation and disposal to the landfill. Waste Container shall be covered and locked at all times the Contractor is not on site, to prevent access to the public. Upon completion of the removal, Contractor shall visually inspect the adjacent areas for possible ACM debris. **Contractor shall leave the site clean and free of ACM debris**.

GENERAL REQUIREMENTS - ASBESTOS

Upon completion of the ACM removal and final cleaning, Environmental Consultant (ENV) will perform a visual inspection of each work area. At such time that the work area passes visual inspection, Contractor will encapsulate the work area in accordance with specifications. Contractor shall not encapsulate concrete floors. Environmental Consultant will perform final air clearance testing in accordance with AHERA regulations and specifications. If clearance test results do not meet clearance criteria, as defined in Section 020915, Contractor is responsible to re-clean at no additional cost to Owner and may be responsible for additional costs related to the additional final clearance sampling and analysis. For this project, clearance sampling will be by

PCM or TEM analysis, based on the quantities and types of materials abated, and removal procedures used (friable, non-friable) in each given work area.

It is the intent for electrical and water service to be made available by the District for Contractor use during the abatement portion of the work; Abatement Contractor is responsible for all connections and supplying electric and water to actual work areas, as necessary, to perform the work detailed in these specifications. Abatement Contractor is also responsible for verifying whether a sufficient power source is available for operating equipment necessary to perform the work as specified or shall provide the necessary means for power and include all costs in Bid.

3.2 ASBESTOS-CONTAINING MATERIALS

The following asbestos containing materials are known or assumed to be present at the worksite based upon the asbestos inspection and sampling; if any other materials are found which are suspected of containing asbestos, immediately notify ENV:

Sound Insulation Wrap (1871/1918 buildings – above plaster ceilings)
Pipe Insulation (1894 building, assumed above ceilings/inside walls throughout)
Interior Window Caulk and Glazing (original exterior of 1871 building)
Exterior Window Caulk and Glazing (1894 building)
Original Chalkboard Adhesive – Throughout (Assumed)

3.3 AIR MONITORING

A. Owner will contract with a third party to have asbestos abatement oversight, air monitoring, and final air clearance air quality testing performed for this project. Contractor is to cooperate fully with the Environmental Consultant. The OSHA PEL of 0.10 fibers/cc will be used to determine effectiveness of contractor work practices and removal procedures. Air sampling of employee breathing zone required by OSHA regulations (Personal Monitoring), and subsequent PPE, is the responsibility of the Contractor. Daily air sampling results during removal determined to be above the OSHA PEL will result in a WORK STOP, until corrective actions are taken.

3.4 OWNER OCCUPANCY

A. The Owner will move out and vacate the building for the duration of the abatement and renovations. Owner's Representatives and other Prime Contractors will occupy portions of the existing building during the period of abatement. Cooperate fully with Owner's Representatives and other Prime Contractors to minimize conflicts and facilitate work. Perform the work so as not to interfere with operations and work being performed by others.

3.5 SUBMITTALS

A. Asbestos Abatement Notification
B. Work Plan and Waste Management Plan
C. Safety Data Sheets (SDS), as applicable
D. Proposed Waste Hauler and Landfill
E. Asbestos Abatement Contractor License
F. Asbestos Abatement Worker and Supervisor Licenses
G. Sub-Contractors (if applicable)

END OF SECTION

SECTION 00 31 32 – INFORMATION AVAILABLE TO BIDDERS

1.1 This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but do not affect Contract Time requirements. This Document and its attachments are not part of the Contract Documents.

1.2 Information included in this document consists of the following attachments:

A. Sewer Camera Inspection Sketch by Blood Hound Underground Utility Locators, LLC, prepared for Council Rock School District, dated December 23, 2025 (1 page).
B. Existing Utilities Sketch by Peak Utility Locators, prepared for Earth Engineering Incorporated, dated December 24, 2025 (1 page).
C. Report of Geotechnical Investigation by Earth Engineering Incorporated, dated March 5, 2026, (34 pages).
D. Infiltration Investigation Letter from Earth Engineering Incorporated, dated March 6, 2026, (4 pages).

1.3 OWNER'S VENDORS:

A. Note that that the Owner is procuring and/or has procured additional Vendors to perform work that is associated with the Project, but is not included in the Prime Construction Contracts. The Prime Contractors' Scopes of Work will be affected by the Vendors' Scopes of Work. Refer to Section 01 1200 - Multiple Contract Summary for additional information.

B. Vendors' Drawings and other Documents are being provided for informational purposes only, for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but do not affect Contract Time requirements. Vendors' Attachments are not part of the Building Bid Package's Contract Documents.

C. Owner's Vendors include, but are not limited to, the following:
1. Security, Access Control and Audio/Visual.
2. Furniture, Fixtures, and Equipment Vendor (FFE).

END OF SECTION 00 31 32

Work order#: **00296602**
Work type: **Sewer Camera Inspection**

Client: **Council Rock School District**
Project Manager: **Robert Bergen**

Address **30 N Chancellor St, Newtown, PA, 18940**

Scale: **NTS**
Date: **12/23/2025 10:22:45 AM**

Legend

- Elec. Area Light Pole
- Storm Manhole
- End of Information
- Storm Roof Drain
- Sanitary Cleanout
- Sanitary Line
- Storm Cleanout
- Storm Line

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BLOOD HOUND
UNDERGROUND UTILITY LOCATORS

6500 Technology Center Drive Suite 200
Indianapolis, IN 46278
1-888-858-9830

You should always have public utilities located by 811 before digging.

1. Utility Information

The subsurface utilities depicted are for informational purposes only. Blood Hound is not a licensed surveying or engineering firm. Independent verification is required for any official use, including design or construction.

2. Utility Detection Limitations

Subsurface utility detection was conducted using methods that may include electromagnetic (EM) locating and/or ground-penetrating radar (GPR). The accuracy of these methods can be affected by electromagnetic interference, soil composition, and groundwater conditions.

3. Depth Accuracy

Unless confirmed through test holes (potholing), any subsurface utility depths shown were estimated using EM or GPR technologies and are approximate.

4. GNSS Equipment and Accuracy

Utility locations were designated using a vLoc3 RTK-Pro GNSS receiver unless otherwise noted. GNSS data accuracy is subject to limitations based on signal quality, environmental factors, and equipment tolerances.

Web Map Viewer Terms

5. Utility Data in Viewer

The web map viewer provides access to utility data collected during fieldwork. This data is for informational purposes only and should not be used for design or construction without independent verification.

6. Basemap Alignment

Google Satellite imagery has varying levels of positional accuracy. As a result, collected features will be accurately placed in their real-world locations but may not align precisely with the basemap.

7. Data Validity

Utility data reflects site conditions at the time of collection. Changes to site conditions may occur, and the data may no longer be accurate over time.

8. Access Duration

The web map viewer link will remain active for 6 months and will be deactivated afterward. For extended access, please contact our team at bhugcad@bhug.com

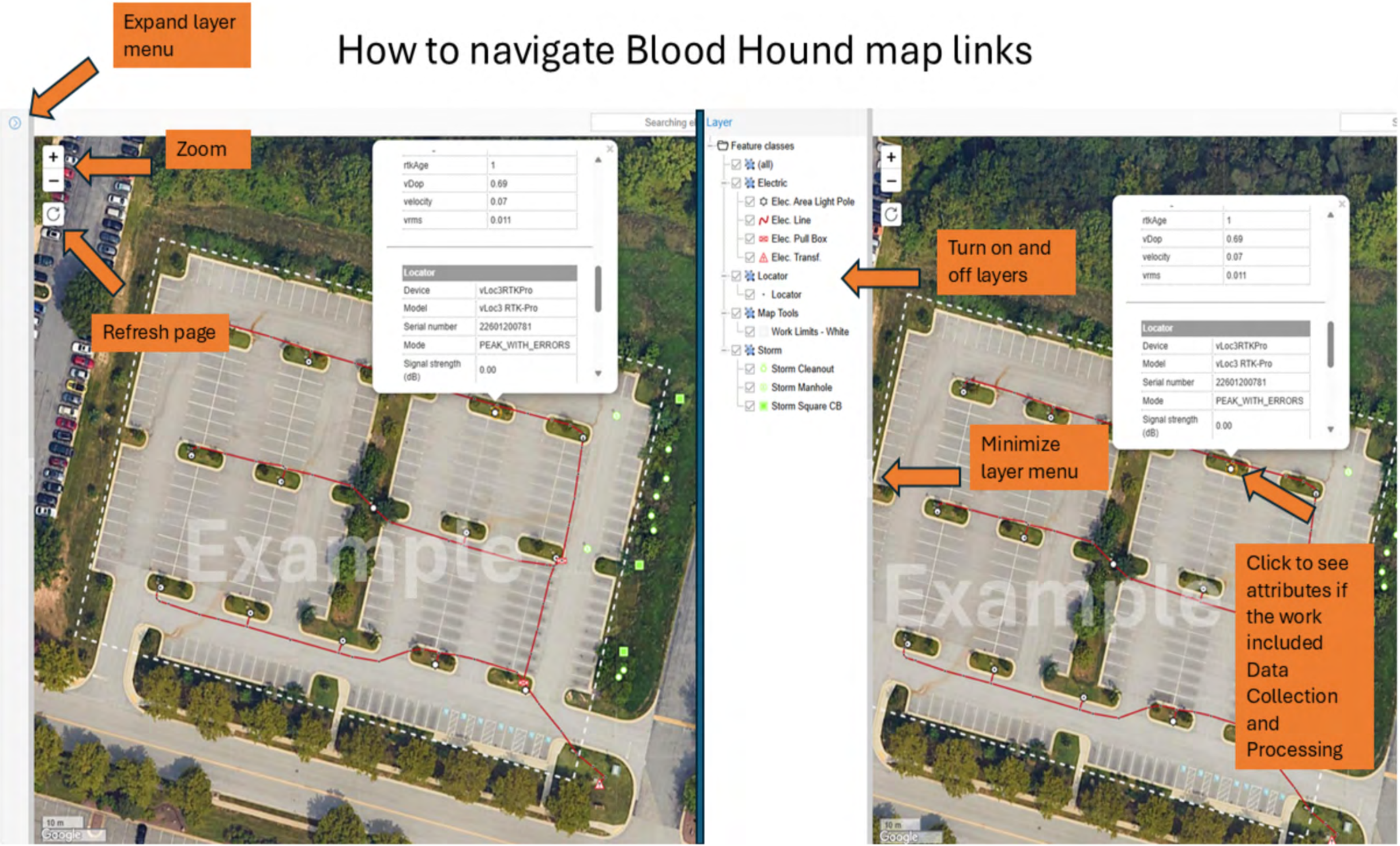
9. Agreement to Terms

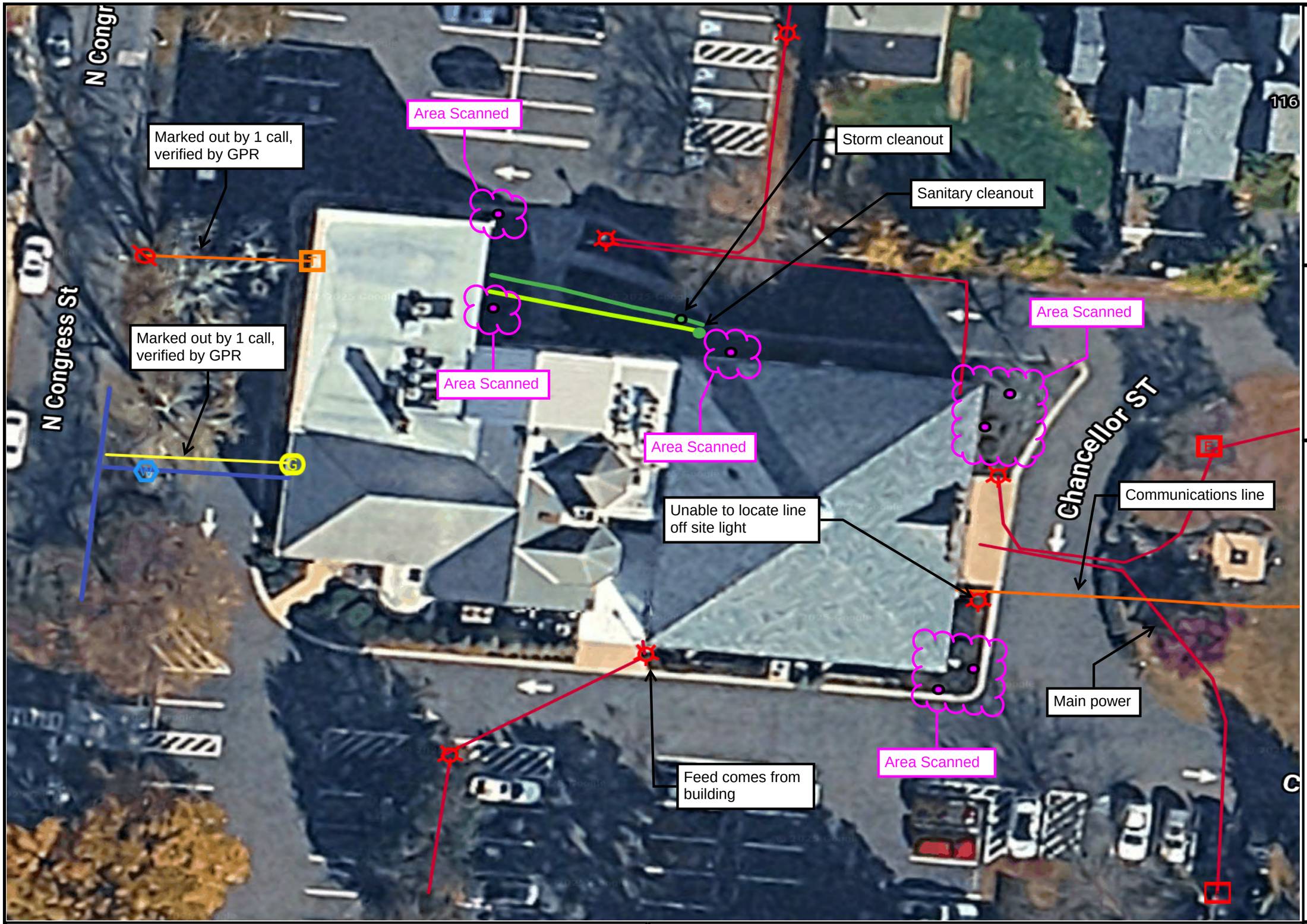
By accessing the web map viewer link below, you acknowledge and agree to these terms and conditions.

https://bhug.geolantis.com

Use Edge or Chrome to open the map link.

How to navigate Blood Hound map links





PEAK UTILITY LOCATORS

info@peakul.com
PeakUtilityLocators.com
(855) 4-PeakUL
(855) 473-2585

Technician:
Brody C / Camilo R

Service Date:
Dec 24th 2025

Peak Job #:
83704260

LEGEND

- Assumed Location
- Electric
- Communications
- Water
- Gas
- Storm Sewer
- Sanitary Sewer
- Unknown Utility
- Manhole
- Junction Box
- Utility Pole
- Valve
- End of Information
- Inlet
- Clean Out
- Site Light

PROJECT: Council Rock School District Administration Building

PREPARED FOR: Earth Engineering Incorporated

SHEET: ____ of ____

EARTH ENGINEERING INCORPORATED

Geotechnical Engineers & Geologists

REPORT OF GEOTECHNICAL INVESTIGATION

COUNCIL ROCK SCHOOL DISTRICT – CHANCELLOR CENTER

30 NORTH CHANCELLOR STREET

NEWTOWN, PENNSYLVANIA

Prepared For:
Christopher Peters, AIA
Marotta Main Architects
Lancaster, PA 17602

EEI Project No. 39222.00

March 5, 2026

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Boring Profile

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Boring Logs
Test Pit Logs
Laboratory Testing Results

I. INTRODUCTION AND BACKGROUND

A. PROJECT OBJECTIVE AND SCOPE OF WORK

Earth Engineering Incorporated (EEI) has completed the geotechnical investigation for the Council Rock School District – Chancellor Center located at 30 North Chancellor Street, Bucks County, Newtown, Pennsylvania. It is EEI's understanding that the existing Chancellor Center Building is experiencing groundwater intrusion in below grade spaces. The objective of this investigation is to attempt to determine the steady state groundwater table and identify sources of water infiltration into the basement level of the east wing of the existing building. Particularly, along the eastern basement wall. Additional areas of water infiltration are present with other areas of the building, but these are likely the result of roof and façade drainage issues.

Based on the conditions encountered and the results of geotechnical analyses performed for this project, EEI has developed remedial recommendations for the existing building.

The scope of work for this project included a test boring and test pit investigation, geologic analysis of site conditions, laboratory testing of soil samples, and groundwater observations obtained from the site. This investigation was performed in general accordance with EEI Proposal No. BB-23954 dated December 4, 2025. The following report sections present the results of the field and laboratory investigations and document recommendations regarding the groundwater conditions of this project.

B. EXISTING FEATURES AND PROJECT DESCRIPTION

The project site is located at 30 North Chancellor Street, Newtown, Pennsylvania. The project area is encompassed by the existing Chancellor Center building. The building is bordered to the north, south, east, and west by existing asphalt driveways and parking areas. Based on the Topographic and Partial Boundary Plan by Barry Isett & Associates Inc. provided to EEI by the Client, the grades at the site slope shallowly downward from east to west from elevation 188.0 feet to 180.0 feet.

A topographic map of the site, from the *Topographic Maps of Pennsylvania* series, Langhorne Quadrangle, is shown in Plate 1 in the *Figures and Drawings* at the end of this report.

Figure 1: Site Location (Google Earth, 2026)

II. FIELD INVESTIGATION, OBSERVATIONS, AND DATA

A. FIELD ACTIVITIES AND PROCEDURES

1. Test Borings

Four (4) test borings, denoted in this report as B-1 to B-4 were conducted for this investigation to obtain geotechnical parameters within the investigation area around the existing building. All borings were conducted within close proximity of the existing building and completed on December 30th, 2025. The borings were completed by Main Line Drilling, of Wayne PA using a Mobile B-57 truck rig. Supervision and monitoring of the test boring program was performed by representatives of EEI. Figure 2 below shows the approximate location of the Test Borings. Elevations for the test borings were estimated by using site features and the provided plans.

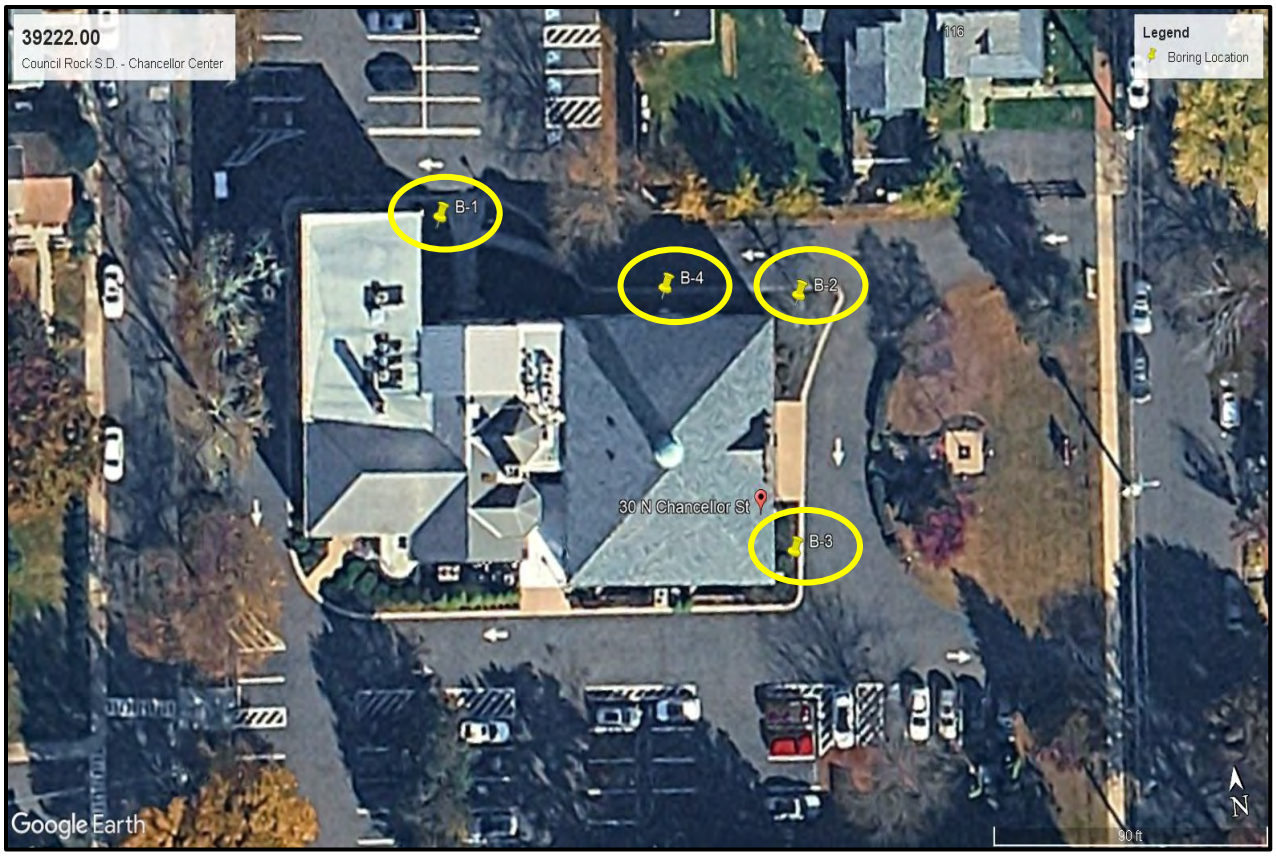


Figure 2: Approximate Boring Locations

The borings were advanced using 2-inch outer-diameter, split-barrel (spoon) samplers and 3.25-inch inner-diameter hollow-stem augers. Split-barrel sampling was conducted with an automatic hammer. The borings were conducted in accordance with ASTM Standard D1586. Standard Penetration Test (SPT) values were recorded for each sample. The SPT values, which are a measure of soil density and consistency, are the number of blows required to drive the 2-inch outer diameter split-barrel sampler 1 foot using a 140-pound weight dropped 30 inches. The number of blows required to advance the sampler over the 12-inch interval from 6 to 18 inches is considered the "N" value, or the SPT value.

2. Groundwater Observation Well Installation

EEI installed three (3) monitoring wells on the site for the purpose of identifying groundwater elevation. The wells were installed to depths ranging from 8.0 to 10.5 feet below ground surface in boring locations B-1, B-2, and B-3. The wells were constructed of 2-inch pvc casing with a 5-foot screened interval. The annulus surrounding the screened interval was filled with clean sand to facilitate development. Each well is constructed according to the PADEP

monitoring well guidelines including bentonite seal at the top of the sand pack and a flush mounted well cover/enclosure.

3. Exploratory Test Pits

Five (5) test pits denoted TP-1, TP-2, TP-3, and TP-4, and one offset test pit TP-3A were excavated by Wayne Carmint Landscaping of King of Prussia, PA on January 23rd, 2026 utilizing a Kubota U35-4 mini track-hoe. The test pits were excavated to depths ranging from 4.0 to 8.4 feet below existing grade. Test pits TP-2, TP-3, TP-3A, and TP-4 were conducted to determine the depth and condition of the existing foundations of the existing building. It should be noted that TP-4 was abandoned after encountering an unmarked buried utility and no meaningful footing data could be retrieved at this location. Test-pit TP-1 was conducted in the lawn area to the north of the existing building for infiltration testing and will be reported under a separate cover. The locations and existing surface elevations of each testing location were interpolated from the from the provided plans. Figure 3 below shows the approximate location of the Test Pits.

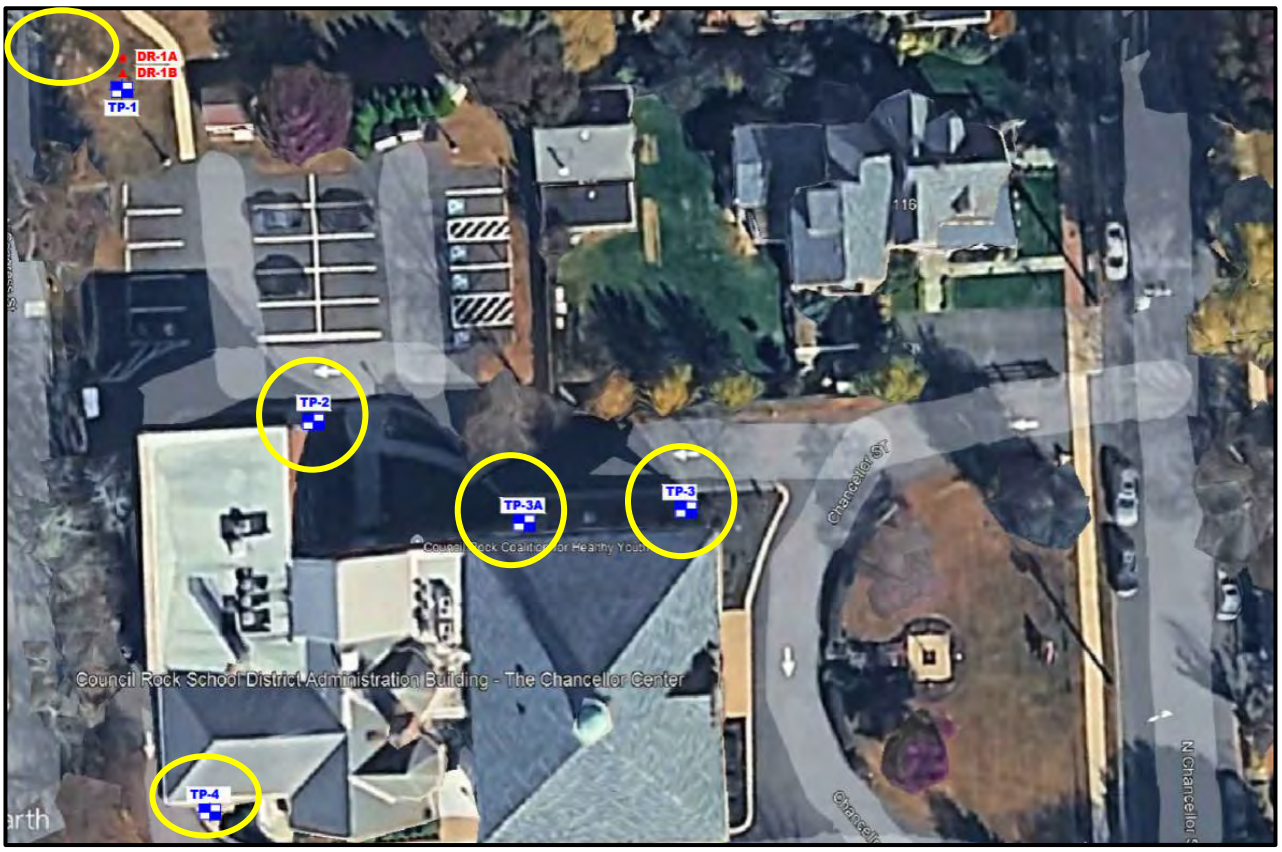


Figure 3: Approximate Test Pit Locations

4. Roof Leader and Window Well Drainage Pathing

EEI identified the locations of the various roof drain downspouts (RD1 to RD12), window-well drains (WD1 to WD4) and drainage outlet pipes along N. Congress Street (C1 to C6).

Additionally, two existing cisterns are present below the basement level within the north-west building wing. These are denoted as the East Cistern and West Cistern in this report. The hydraulic connection between these cisterns has not been determined.

Based on the Sewer Camera Inspection report completed by Bloodhound Underground Utility Locators (Bloodhound) on December 23rd, 2025, the discontinuation of the underground pipe is suspected to be from a third suspected cistern identified in the parking lot adjacent to the northwest corner of the building.

The locations of these various drainage features are shown on Figure 4 below.

In an effort to collect data on the drainage pathing of these various drainage features, EEI coordinated with Boyle Construction to introduce water into the various roof drains and window well drains around the building on January 23rd, 2026. Using a hose, EEI introduced a steady flow of water into each roof drain, and each window-well drain around the building. While water was flowing in the system, EEI monitored other roof drains and window-well drains for visual and/or audible water flow while Boyle Construction observed the east and west Cisterns, and the curb outlets. Boyle Construction then relayed to EEI where the water flow was noted.

Figure 4 – Existing Drainage Features

B. GEOTECHNICAL LABORATORY TESTING

Two (2) representative soil samples were recovered from the field investigation for laboratory testing. The laboratory testing was performed to verify visual classifications and to establish engineering parameters required for geotechnical engineering analysis. The tests performed included Particle Size Analysis (ASTM D2487) and Natural Moisture Content (ASTM D2216). A Unified Soil Classification System (USCS) Group Symbol and ASTM Group Name was assigned to the sample based on the laboratory testing. The results of the laboratory testing are presented in the following table. Gradation curves, which graphically and numerically depict the results of the analyses, are included in the *Appendix*.

TABLE I LABORATORY RESULTS – SOIL CLASSIFICATION		
Sample Location	B-1, B-2	B-4
Sample Number	S2, S3 & S2	S-4 & S-5
Sample Depth (feet)	20.0'-4.0' & 4.0'-6.0'	6.0'-8.5'
Stratum	Stratum I	Stratum II
Atterberg Limits		
Liquid Limit	30	NP
Plastic Limit	20	NP
Plasticity Index	10	NP
Natural Moisture Content (%)	21.0	18.3
Percent passing № 200 Sieve	63.0	56.0
Unified Soil Classification System (USCS) Group Symbol	CL	ML
ASTM Group Name	Sandy Lean Clay	Sandy Silt

C. PUBLISHED GEOLOGICAL INFORMATION

According to the Commonwealth of Pennsylvania Topographic and Geologic Survey, *Atlas of Preliminary Geologic Maps of Pennsylvania*, 1978, Langhorne Quadrangle, the site is situated within an area of the Triassic Period Stockton Formation (Geologic Symbol: Trs). Plate 2, included in the Appendix, shows the location of the site on a geologic map of the area.

As noted in the Commonwealth of Pennsylvania Topographic and Geologic Survey, *Engineering Characteristics of The Rocks of Pennsylvania*, Fourth (4th) Series, Revised 1982, the Stockton Formation (Trs) is composed of beds of red to purple sandstone, shale, and siltstone, along with light gray to buff-colored arkosic sandstone. The bedding within this formation is typically well developed and thin to flaggy. The fracturing and jointing within this rock type have a blocky pattern. This rock type is moderately resistant to weathering, and the overlying soil mantle is typically thin. Moderate porosity and permeability are characteristic of this formation. Ease of excavation ranges from easy in the highly to completely weathered rock, to difficult in the moderately weathered to fresh bedrock. Localized groundwater springs are a common occurrence within the fractured bedrock of the Stockton Formation.

Based upon the soils observed during the field investigation, the conditions at the site appeared typical of the red to brown sandstone and siltstone of the Stockton Formation.

III. SUMMARY OF FINDINGS

A. STRATIFICATION AND SUBSURFACE CONDITIONS

The samples of soil obtained during the field investigation were examined and visually classified by EEI, both in the field and in the laboratory. EEI has generalized the subsurface profile for the investigated area. EEI encountered surficial topsoil at each boring and test-pit location that was found to range from 1.0 inch to 8.0 in thickness. Beneath the surficial materials existing FILL was encountered at boring location B-3 and test-pits TP-1 to TP-4. Beneath the surficial topsoil and Existing FILL, three naturally occurring soil strata were encountered.

A *Subsurface Profile*, which depicts the strata, and other information obtained from the field investigations is included in the Figures and Drawings. Detailed descriptions and data regarding the subsurface conditions are shown on the *Boring Logs,* also in the Appendix. The following subsections provide general descriptions of the materials encountered.

1. Existing FILL

The materials designated as Existing FILL consists of poorly graded sand with gravel, and rock fragments. The corresponding ASTM Group Name is *poorly graded sand*. The existing FILL material extended to a depths ranging from 3.8 feet to 8.0 feet. The SPT values recorded during the sampling of this soil ranged from 9 blows per foot of penetration to 17 blows per foot of penetration and degree of excavation difficulty ranged from easy to moderate. Based on these values, the relative density of the Existing FILL ranges from loose to medium dense. These materials were encountered in a moist state during the field investigation.

2. Stratum I: Residual

The soils designated as Stratum I are indicative of residual soils. This stratum was visually classified and confirmed by laboratory testing to consist of a sandy lean clay. The USCS Group Symbol for a representative sample of this material is *CL*. The corresponding ASTM Group Name is *clayey sand*. Stratum I soils were encountered beneath topsoil at B-1, B-2, and B-4 and beneath Existing Fill at TP-1, to depths ranging from 5.0 to 8.0 feet below existing grade.

The SPT values recorded during the sampling of this soil ranged from 5 blows per foot of penetration to 20 blows per foot of penetration. The degree of excavation difficulty was easy. Based on these values, the consistency of Stratum I ranges from loose to very stiff. Generally, these soils were found to be in a stiff state. As indicated by laboratory testing, the natural moisture content of a representative sample of Stratum I was measured to be 21.0 percent.

3. Stratum II: Decomposed Sandstone

The soils designated as Stratum II are indicative of residual soils. This stratum consists of a silty fine sand to sandy silt, trace to some gravel. The USCS Group Symbol for a representative sample of this material is *ML*. The corresponding ASTM Group Name is *sandy silt*. The Stratum II soils were encountered beneath either Existing Fill or Stratum I soils at boring locations B-3 and B-4, and test pits TP-1 and Tp-3a to depths ranging from 6.5 to 8.0 feet below existing grade.

The SPT values recorded during the sampling of this soil ranged from 21 blows per foot of penetration to 42 blows per foot of penetration and the degree of excavation difficulty was moderate. Based on these values, the consistency of Stratum II ranges from medium dense to dense. Samples of these soils were found to be moist. As indicated by laboratory testing, the natural moisture content of a representative sample of Stratum I was measured to be 18.3 percent.

4. Stratum III: Weathered Sandstone

The material designated as Stratum III is visually described as weathered sandstone in the form of a gravelly fine sand with silt. The assigned ASTM Group Names are *gravelly sand with silt*. Stratum III was encountered directly beneath either Statum I or Stratum II soil at each boring location and extended to depths ranging from 8.0 to 10.5 feet below existing grade. It is noted Stratum III was not encountered in the test pits to the depths explored. Each boring terminated in Stratum III material. This stratum was encountered in a saprolitic state. A saprolite is a soil which has undergone significant weathering but still maintains its remnant foliation and mineral integrity.

The N-values recorded during the sampling of this material were greater than 50 blows per foot of penetration. Based upon the N-values, as well as monitoring of the drilling rates, the relative density of this material is very dense. Moisture level observations of this stratum ranged from moist to dry. The degree of difficulty during the drilling within Stratum III was hard drilling and generally increased in drilling difficulty with depth.

5. Bedrock

Auger refusal was encountered at each boring location at depths ranging from 8.0’ to 10.5’ feet. For this report purposes, bedrock is defined as auger refusal within residual materials where there is no significant advancement of the rotating auger drill bit for the type of drilling equipment used. Very dense weathered rock, as indicated by hard drilling rates and/or N-values of greater than 50 blows per foot, was encountered at each boring location at initial depths ranging from 6.0 to 8.0 feet. The depth to very dense weathered rock and bedrock with corresponding elevations are shown in the following table.

TABLE II DEPTHS TO VERY DENSE WEATHERED ROCK AND BEDROCK					
Boring Location	**1.) Ground Surface Elevation (feet)**	**2.)3.) Approximate Depth to Very Dense Weathered Rock (feet)**	**Approximate Very Dense Weathered Rock Elevation (feet)**	**2.) Approximate Depth to Bedrock (Auger Refusal) (feet)**	**Approximate Bedrock Elevation (feet)**
B-1	182.5	8.0	174.5	10.5	172.0
B-2	187.5	6.0	181.5	8.0	179.5
B-3	187.2	6.5	180.7	10.5	176.7
B-4	185.8	8.0	177.8	9.0	176.8

1.) The ground surface elevation at each boring location was topography estimated.
2.) The depth is relative to existing grade at the time of the investigation.
3.) Very dense weathered rock is defined as having an "N" value of greater than 50 blows per foot of penetration.

B. GROUNDWATER OBSERVATIONS

Groundwater measurements were taken in each boring during the boring investigation. Groundwater was not encountered in the borings to the depths explored. Furthermore, to facilitate long-term groundwater monitoring, groundwater wells with flush mounts for longer term groundwater readings were installed in B-1, B-2, and B-3. Additional groundwater measurements were taken on January 3rd, 2026, January 19th, 2026, and January 23rd, 2026. Groundwater was not encountered in any of the monitoring wells at any of the times the measurements were taken.

C. TEST PIT FINDINGS

Test pit TP-1 was excavated in the grass area adjacent to the eastern parking lot. This test pit was for preliminary infiltration testing.

Test pit TP-2 was advanced along the north-west wing of the building. The existing foundation wall was found to consist of stacked stone and mortar with a parge covering bearing on a cast in place concrete footing. The foundation bottom was found to be at a depth of seven (7) feet below existing surface elevation. The protrusion of the cast in place foundation extended fourteen (14) inches away from the foundation wall and was fourteen (14) inches in thickness.

Figure 5: Test Pit 2

Test pits TP-3 and TP-3A were excavated along the eastern side of the southern building wing (facing N. Chancellor Street). Based on the findings at TP-3 and TP-3A the foundation walls along the east side building consist of un-mortared stacked stone.

Due to access constraints test pits were not able to be excavated deep enough to encounter the bottom of wall. It is our expectation based on evaluations of similar aged structures that the stacked stone wall bears directly on the native soils with not typical spread footing present. The bottom of the wall is likely located just below the basement elevation.

The test borings conducted adjacent to this portion of the building (B-2 and B-4) found rock as determined by auger refusal at an elevation similar to the basement slab elevation. Auger refusal was encountered at 8.0 feet in B-2 and 9.0 feet in B-4. Accordingly, it is reasonable to assume that the bottom of wall is bearing on the underlying rock.

Figure 6: Test Pit 3A

D. ROOF DRAIN PATHING

Based Sewer Camera Inspection report completed by Bloodhound and on the introduction of the water and discharges in the various site drainage features EEI has been able to identify the drainage path of most of the existing drainage features. Our understanding of the drainage features path is shown in Figure 7 below.

Roof drain RD1 discharges underground a is directly connected to the curb outlet C2 on N. Congress Street. Roof drains RD2, RD3, RD4, and RD5 all drain onto the adjacent ground surface. Evidence of that these roof drains previously went underground rather than discharging on the ground was observed. It is suspected that these may have formerly discharged into one or several of the existing curb outlets along N. Congress Street.

Upon introducing water to roof drain RD6 there was no visual outfall of the water. The Sewer Camera Inspection report completed by Bloodhound Underground Utility Locators identified an underground piping from RD6 to a suspected cistern in the parking lot adjacent to the northwest corner of the building. While introducing water into roof drain RD6, EEI audibly noted the flow water in curb outlet C6. Based on this finding, EEI suspects that RD6 drains into the suspected cistern underneath the south parking lot and likely ultimately discharges into curb outlet C6 along N. Congress Street as an overflow.

EEI also observed that roof drains RD7, RD8, and RD9, along the south side of the building are all connected and discharge at curb outlet C5 on N. Congress Street. Window wells WD3 and WD4 were clogged so collection of data on their drainage path was possible. It is likely that these window wells drain to curb outlet C5 when functioning.

Upon introducing water to roof drains RD10, RD11, and RD12 and window well drains WD1, and WD2 it was concluded that these all ultimately discharge into the East Cistern. The window well drains WD1, and WD2 may enter the building under the floor slab and then tie into the roof drainage system.

The outfall of the East Cistern is unknown. Additionally, the hydraulic connection between the East and West Cisterns is unknown along with any potential outfall of the West Cistern. The volume of water introduced into the East Cistern may not have been sufficient to create an outfall into the West Cistern. Curb outlets C1, C3, and C4 remained dry during this investigation with no discharge while introducing water into the various drainage features. These may be potential outfalls of either or both Cisterns.

Figure 7: Roof Drain Pathing Findings

IV. RECOMMENDATIONS

The subsurface conditions in the area adjacent to the existing building are characterized by loose to medium dense Existing Fill, loose to medium dense Stratum I, medium dense to dense Stratum II and very dense Stratum III soils. The east wing basement walls are stacked stone which are not mortared on the exterior. Since rock as rock as determined by auger refusal was encountered at the basement elevation, it is likely that these walls bear directly on rock with not spread footing. The foundations for the northwest-wing were found to be cast in place spread footings at a depth of 7.0 feet supporting the overlying stacked stone basement wall. This wall was found to have a parge covering along the exterior. No water proofing was noted on any basement walls.

The groundwater monitoring wells did not indicate the presence of any water during any of the investigations. Additional groundwater elevations will be recorded seasonally and in response to observation of water infiltration into the basement.

EEI recommends water proofing of the existing foundation walls. Additionally, the window wells appear to be in structural distress with bulging evident. It is our understanding that these are to be reconstructed. We would recommend water proofing the exterior of the walls.

The existing roof drainage, especially on the east wing are discharged underground. This not recommended due to potential for clogging and or failure of the piping. Furthermore, with the exception of the north side of the eastern wing (RD10 to RD12), the existing roof drainage is directed towards N. Congress Street. Therefore, we would recommend directing this drainage directly to the surface rather than underground. Since this water is currently discharging onto N. Congress Street it should be acceptable to divert this to surface flow.

On the north side of the eastern wing (RD10 to RD12 and WD1 and WD2) the roof and window well drainage is being directed to the East Cistern. Determination of the hydraulic connection between the East and West Cisterns should be determined along with potential outfalls of these Cisterns.

Introduction of roof and window well drainage to the interior of a building is not recommended. Therefore, we would recommend discharge of the roof drainage to the surface. The window wells should be directed to a sump that can be discharged onto the surface on an existing drainage feature.

If it can be confirmed that the existing cisterns are draining to the curb outlets along N. Congress Street, then an argument could be made that diverting the roof drains to the surface is not increasing the stormwater flow. An offset system designed as a managed release concept might be required to satisfy regulatory stormwater management concerns.

V. LIMITATIONS

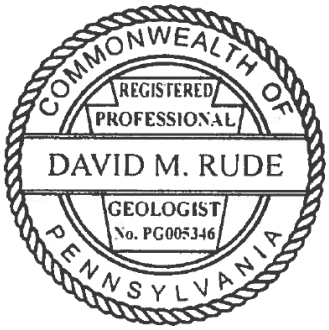
The conclusions and recommendations presented in this report are based on the subsurface data collected, details stated in this report, and the assumption that the subsurface conditions do not deviate from those disclosed by the data acquisition activities performed. It is recommended that the final foundation plans be made available to EEI for review. Any substantial change in the proposed plans should be brought to the attention of EEI so that the impact of the change on the recommendations presented herein may be evaluated.

The procedures followed during the subsurface exploration, and the analyses and conclusions contained herein, have followed generally accepted practices of geotechnical

engineering. EEI provides no other warranties, either expressed or implied, as to the professional advice provided under the terms of EEI's agreement and included in this report. The conclusions and recommendations presented in this report are based on the assumption that recognized, proper construction practices will be followed throughout construction and that a Professional Engineer qualified in Geotechnical Engineering will be retained to oversee the inspection of site preparation, proof-rolling, foundation construction, and other critical earthwork operations. If subsurface conditions substantially deviate during construction from those described in this report, EEI should be contacted promptly.

EEI emphasizes that geotechnical parameters and recommendations made in this report are for the existing office building at 30 N Chancellor Street Newtown, Pennsylvania. EEI does not assume any responsibility for the use of this report in generating a foundation design for a site other than the one specifically addressed in this report.

Respectfully submitted,
EARTH ENGINEERING INCORPORATED



David Rude P.G.
Project Manager / Senior Geologist

Patrick McNamanra, P.E.
Director – Geotehcnial Investigations

https://eengineering.sharepoint.com/sites/EarthEngineeringInc/Shared Documents/Projects/39000/39222.00 - Council Rock S.D. - Chancellor Center - EN Geo/REPORT/39222.00 - Council Rock S.D. - Chancellor Center - Geotech Report.docx

FIGURES AND DRAWINGS

APPENDICES

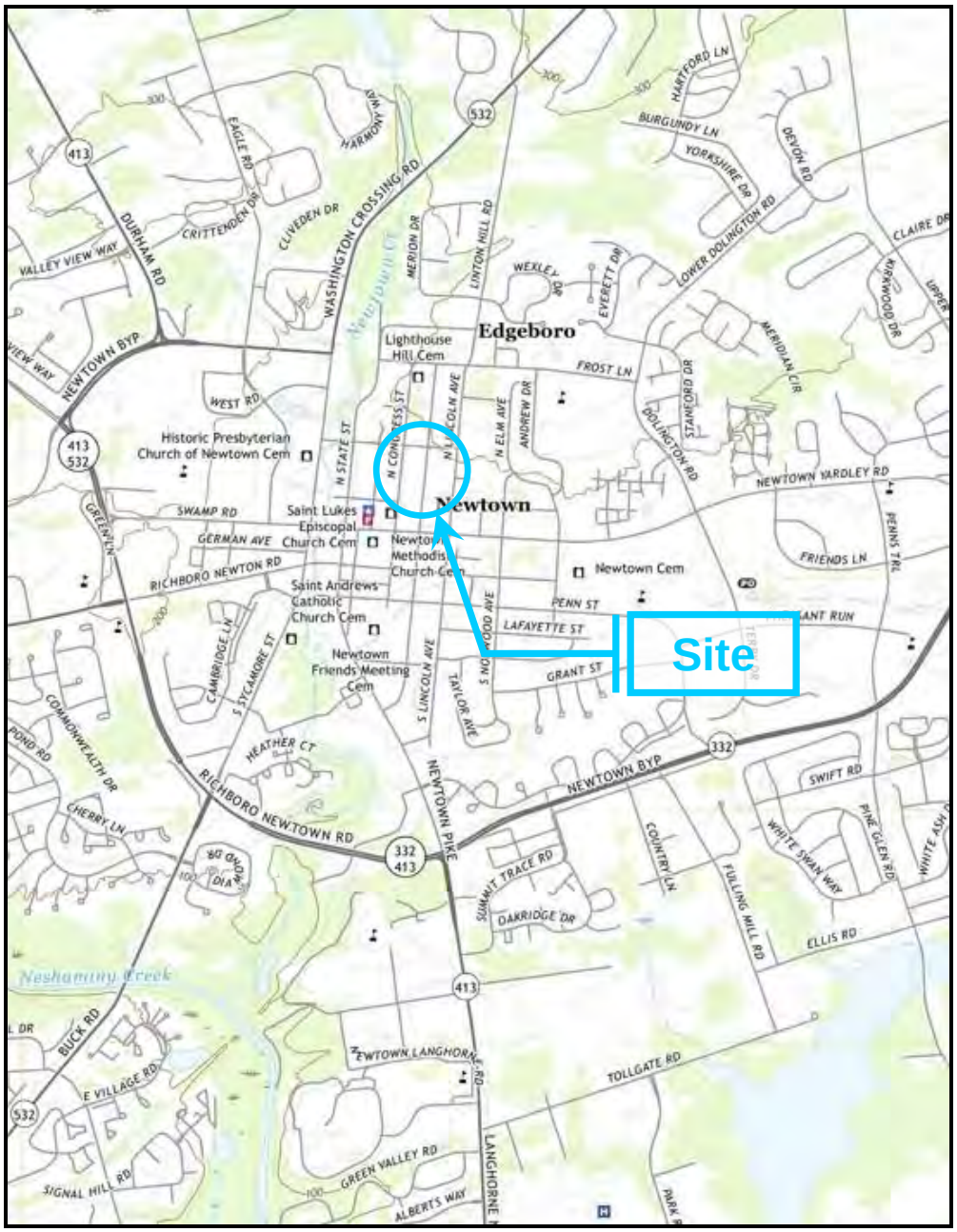


PLATE 1 – TOPOGRAPHIC MAP OF SITE

Reprinted from the United States Department of the Interior Geological Survey, Topographic Maps of Pennsylvania, Langhorne, PA Quadrangle, Photorevised 2021.

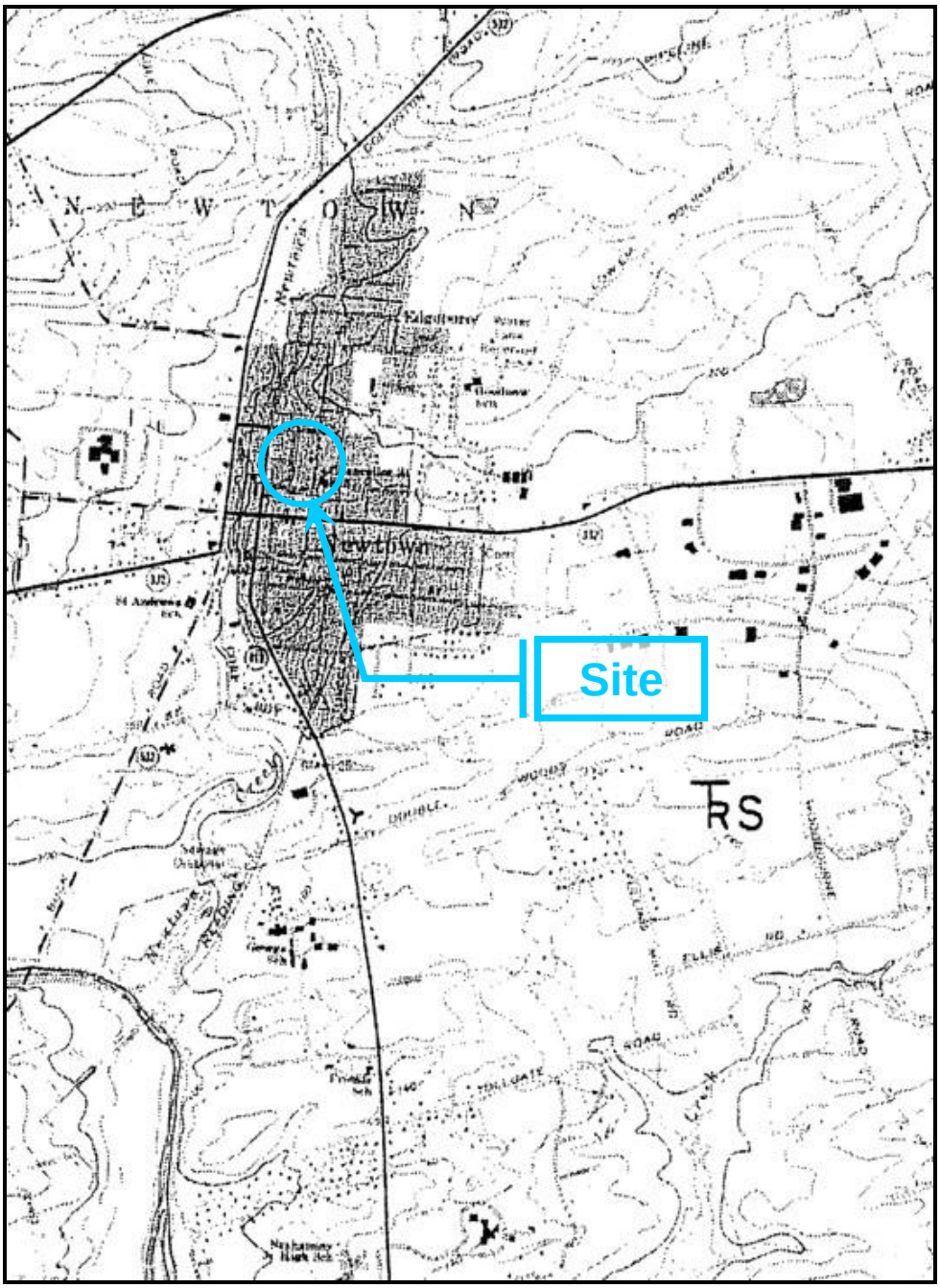
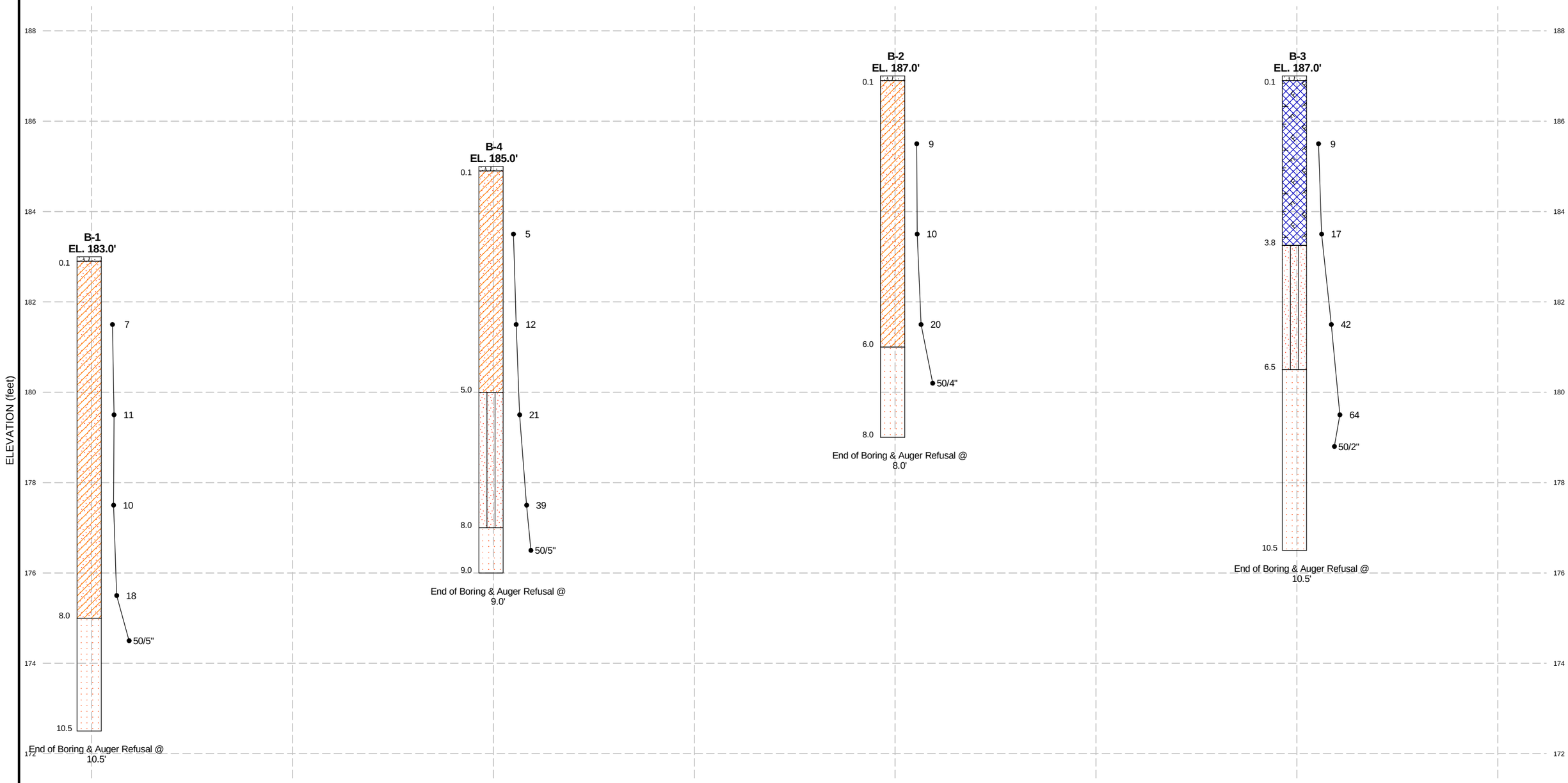


PLATE 2 - GEOLOGIC MAP OF SITE

Reprinted from the Pennsylvania Geological Survey, Atlas of Preliminary Geologic Quadrangle Maps of Pennsylvania, Langhorne, PA Quadrangle, 1978.



Lithology Graphics

- Topsoil
- Fill - Poorly Graded Sand, Trace Silt, Rock Fragments, Trace Glass Fragments Pale Yellow Brown (Existing Fill)
- Stratum I - Clayey Sand with Silt; Pale Reddish Brown
- Stratum II - Sitly fine Sand; trace to Some Gravel; Tan Yellow (Decomposed Sandstone)
- Stratum III - Gravelly fine Sand with Silt, Micaceous, Saprolitic; faint purply reddish brown (Weathered Sandstone)

- Initial Groundwater Level
- Subsequent Groundwater Level

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

BORING PROFILES
PREPARED FOR
COUNCIL ROCK S.D. - CHANCELLOR CENTER
NEWTOWN, PA

Project Number: 39222.00

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

BORING LOG

BORING NO.	B-1
SHEET	1 OF 1
DATE: START	12/30/25
END	12/30/25
SURFACE ELEV. (FT)	183.0

PROJECT NAME: Council Rock S.D. - Chancellor Center
PROJECT LOCATION: Newtown, PA
PROJECT NUMBER: 39222.00
INSPECTOR NAME: J. DaVita
EQUIPMENT USED: Mobile B-57 Truck Rig - With Manual Safety Hammer
DRILLER NAME/COMPANY: B. Corcoran/Main Line Drilling
DRILLING METHODS: 2 Continuous SS sampling 0.0'-10.0; 5' intervals after to 10.5'
AUGER: SIZE: 3.25 ID HSA TOTAL DEPTH: 10.5' ; WATER: DEPTH: NE TIME: 0.25 hrs. DATE: 12/30/2025
CHECKED BY: D.Rude ; DATE: 03/04/26 DEPTH: TIME: DATE:
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
0.0	S1	2 3 4 6	0.8'	-	sc	M		0.1 Topsoil (1) — 182.9 Clayey sand with silt, pale reddish brown (Residual)	0.0'-8.0' - Easy Drilling
2.0	S2	5 5 6 7	0.8'	-	sc	M			
4.0	S3	5 5 5 7	0.8'	-	sc	M			
6.0	S4	7 8 10 14	1.2'	-	sc	M		8.0 — 175.0	
8.0	S5	50/5	0.3'	-	sm	M		Gravelly fine sand with silt, micaceous, saprolite, faint purply reddish brown (Weathered Sandstone) 10.5 — 172.5	8.0'-10.5' - Hard Drilling
8.5									10.5' - Auger Refusal 10.5' - End of Boring 10.5' - Observation Well Installed

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

BORING LOG

BORING NO.	B-2
SHEET	1 OF 1
DATE: START	12/30/25
END	12/30/25
SURFACE ELEV. (FT)	187.0

PROJECT NAME: Council Rock S.D. - Chancellor Center
PROJECT LOCATION: Newtown, PA
PROJECT NUMBER: 39222.00
INSPECTOR NAME: J. DaVita
EQUIPMENT USED: Mobile B-57 Truck Rig - With Manual Safety Hammer
DRILLER NAME/COMPANY: B. Corcoran/Main Line Drilling
DRILLING METHODS: 2 Continuous SS sampling 0.0'-8.0'
AUGER: SIZE: 3.25 ID HSA TOTAL DEPTH: 8.0' ; WATER: DEPTH: NE TIME: 0.25 hrs. DATE: 12/30/2025
CHECKED BY: D.Rude ; DATE: 03/04/26 DEPTH: TIME: DATE:
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
0.0	S1	2 4 5 6	0.8'	-	sc	M		0.1 Topsoil (1) 186.9	0.0'-6.0'- Easy Drilling
								Clayey sand with silt, pale reddish brown (Residual)	
2.0	S2	5 5 5 6	1.0'	-	sc	M			
4.0	S3	7 8 12 40	0.8'	-	sc	M		6.0 181.0	
6.0	S4	45 50/4	0.7'	-	sm	M		Gravelly fine sand with silt, micaceous, saprolite, faint purply reddish brown (Weathered Sandstone)	6.0'-8.0' - Hard Drilling
6.8								8.0 179.0	
									8.0' - Auger Refusal
									8.0' - End of Boring
									8.0' - Observation Well Installed

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

BORING LOG

BORING NO.	B-3
SHEET	1 OF 1
DATE: START	12/30/25
END	12/30/25
SURFACE ELEV. (FT)	187.0

PROJECT NAME: Council Rock S.D. - Chancellor Center
PROJECT LOCATION: Newtown, PA
PROJECT NUMBER: 39222.00
INSPECTOR NAME: J. DaVita
EQUIPMENT USED: Mobile B-57 Truck Rig - With Manual Safety Hammer
DRILLER NAME/COMPANY: B. Corcoran/Main Line Drilling
DRILLING METHODS: 2 Continuous SS sampling 0.0'-10.0; 5' intervals after to 10.5'
AUGER: SIZE: 3.25 ID HSA TOTAL DEPTH: 10.5' ; WATER: DEPTH: NE TIME: 0.25 hrs. DATE: 12/30/2025
CHECKED BY: D.Rude ; DATE: 03/04/26 DEPTH: TIME: DATE:
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
0.0	S1	2 4 5 13	1.5'	-	sm	M		0.1 / 186.9 Topsoil (1)	0.0'-3.75' - Easy Drilling
								Poorly graded sand, trace silt, rock fragments; trace glass fragments; pale yellow brown (Fill)	
2.0	S2	7 5 12 19	1.1'	-	sm	M			
								3.8 / 183.3	
4.0	S3	20 22 20 19	1.1'	-	sm	M		Silty fine sand, trace to some gravel; tan yellow (Decomposed Sandstone)	3.75'-6.5' - Moderate Drilling
6.0	S4	12 20 44 50/4	1.2'	-	sm	M		6.5 / 180.5	
								Gravelly fine sand with silt, micaceous, saprolite, faint purply reddish brown (Weathered Sandstone)	6.5'-10.5' - Hard Drilling
7.8									
8.0				-					
8.2	S5	50/2			sm	M			
								10.5 / 176.5	
									10.5' - Auger Refusal
									10.5' - End of Boring
									10.5' - Observation Well Installed

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

BORING LOG

BORING NO.	B-4
SHEET	1 OF 1
DATE: START	12/30/25
END	12/30/25
SURFACE ELEV. (FT)	185.0

PROJECT NAME: Council Rock S.D. - Chancellor Center
PROJECT LOCATION: Newtown, PA
PROJECT NUMBER: 39222.00
INSPECTOR NAME: J. DaVita
EQUIPMENT USED: Mobile B-57 Truck Rig - With Manual Safety Hammer
DRILLER NAME/COMPANY: B. Corcoran/Main Line Drilling
DRILLING METHODS: 2 Continuous SS sampling 0.0'-9.0'
AUGER: SIZE: 3.25 ID HSA TOTAL DEPTH: 9.0' ; WATER: DEPTH: NE TIME: 0.25 hrs. DATE: 12/30/2025
CHECKED BY: D.Rude ; DATE: 03/04/26 DEPTH: TIME: DATE:
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
0.0	S1	3 2 3 3	0.5'	-	sc	M		0.1 Topsoil (1) — 184.9 Clayey sand with silt, pale reddish brown (Residual)	0.0-5.0'- Easy Drilling
2.0	S2	4 5 7 9	0.1'	-	sc	M			
4.0	S3	8 9 12 20	1.2'	-	sc	M		5.0 — 180.0 Silty fine sand, trace to some gravel; tan yellow (Decomposed Sandstone)	5.0'-8.0'- Moderate Drilling
6.0	S4	20 19 20 15	0.7'	-	sm	M		8.0 — 177.0	
8.5	S5	50/5	0.4'	-	sm	M		Gravelly fine sand with silt, micaceous, saprolite, faint purply reddish brown (Weathered Sandstone) 9.0 — 176.0	8.0'-9.0' - Hard Drilling 9.0'- Auger Refusal 9.0' - End of Boring

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

TEST PIT LOG

PIT NO.: TP-1
SHEET: 1 OF 1
START DATE: 1/23/25
END DATE: 1/23/25
SURFACE ELEV. (FT)

PROJECT NAME: Council Rock Chancellor Center
PROJECT LOCATION: Newtown Borough
PROJECT NUMBER: 39222.00
INSPECTOR NAME: J. DeVita
EQUIPMENT: Kubota U35-4
EXCAVATOR NAME/COMPANY: C. Carmint/Wayne Carmint Landscaping
WATER DEPTH: dry TIME: 3.0 hrs. DATE: 1/23/2025
CHECKED BY: D. Rude DATE: 03/04/26
WATER DEPTH: TIME: DATE:

DEPTH (FT)	USCS	H_2O CONTENT **	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
0.0	oh	m		0.3 Topsoil (3")	Easy excavating 0.0' to 5.25'
0.3	sm	m		Silty Sand; some clay; pale gray (FILL)	
1.0	sc	m		1.0 Sandy Lean Clay; abundant roots; pale yellow-brown (Residual)	DRI seated at 4.5'
5.3	gm	m		5.3 Silty Gravel; some gravel; red-brown (Decomposed Siltstone)	Moderate excavating 5.25' to 7.5'
7.5				7.5	End of test pit at 7.5' Limiting zones: none encountered

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

TEST PIT LOG

PIT NO.: TP-2
SHEET: 1 OF 1
START DATE: 1/23/25
END DATE: 1/23/25
SURFACE ELEV. (FT)

PROJECT NAME: Council Rock Chancellor Center
PROJECT LOCATION: Newtown Borough
PROJECT NUMBER: 39222.00
INSPECTOR NAME: J. DeVita
EQUIPMENT: Kubota U35-4
EXCAVATOR NAME/COMPANY: C. Carmint/Wayne Carmint Landscaping
WATER DEPTH: dry TIME: 3.0 hrs. DATE: 1/23/2025
CHECKED BY: D. Rude DATE: 03/04/26
WATER DEPTH: TIME: DATE:

DEPTH (FT)	USCS	H_2O CONTENT **	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
0.0	oh	m		0.2 Topsoil (2")	
0.2	sm	m		Silty Sand; concrete, sand, subbase stone, gravel cobbles; pale yellow, red-brown (FILL)	Concrete pad 24" in width, 8" in thickness and 15' in length found 18" below surface elevation Stone and mortar foundation wall with parkour wall covering extending to top of footer 7.0' below surface elevation Terra cotta pipe, top of pipe 3.5' below surface elevation Footing protrudes 14" from foundation wall and is 14" in thickness
8.4				8.4	

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

TEST PIT LOG

PIT NO.: TP-3
SHEET: 1 OF 1
START DATE: 1/23/25
END DATE: 1/23/25
SURFACE ELEV. (FT)

PROJECT NAME: Council Rock Chancellor Center
PROJECT LOCATION: Newtown Borough
PROJECT NUMBER: 39222.00
INSPECTOR NAME: J. DeVita
EQUIPMENT: Kubota U35-4
EXCAVATOR NAME/COMPANY: C. Carmint/Wayne Carmint Landscaping
WATER DEPTH: dry TIME: 3.0 hrs. DATE: 1/23/2025
CHECKED BY: D. Rude DATE: 03/04/26
WATER DEPTH: TIME: DATE:

DEPTH (FT)	USCS	H_2O CONTENT **	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
0.0	oh	m		Topsoil (7")	Moderate excavation 0.0' to 4.0'
0.6	sm	m		Silty Gravel; abundant cobbles and gravel; pale yellow (FILL)	Stacked stone foundation wall (no mortar) Easy excavation 4.0' to 8.0' Void at 4.7'
8.0					No footing observed End of test pit at 8.0'

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

TEST PIT LOG

PIT NO.: TP-3A
SHEET: 1 OF 1
START DATE: 1/23/25
END DATE: 1/23/25
SURFACE ELEV. (FT)

PROJECT NAME: Council Rock Chancellor Center
PROJECT LOCATION: Newtown Borough
PROJECT NUMBER: 39222.00
INSPECTOR NAME: J. DeVita
EQUIPMENT: Kubota U35-4
EXCAVATOR NAME/COMPANY: C. Carmint/Wayne Carmint Landscaping
WATER DEPTH: dry TIME: 3.0 hrs. DATE: 1/23/2025
CHECKED BY: D. Rude DATE: 03/04/26
WATER DEPTH: TIME: DATE:

DEPTH (FT)	USCS	H_2O CONTENT **	GRAPHIC LOG	DEPTH	DESCRIPTION	ELEVATION	REMARKS
0.0	oh	m		0.2	Topsoil (2")		Test pit relocated to south side of stair towers Easy excavating 0.0' to 3.75'
0.2	sm	m		3.8	Silty Lean Clay; trace sand, trace to some gravel; pale yellow (FILL)		Stacked stone foundation wall
3.8	gm	m		7.0	Silty Gravel; abundant gravel and cobbles; red-brown (Decomposed Siltstone)		Moderate excavating 3.75' to 7.0' Resistance at 7.0'; unable to determine whether resistance is on footing or oversized cobble End of test pit at 7.0'
7.0							

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

TEST PIT LOG

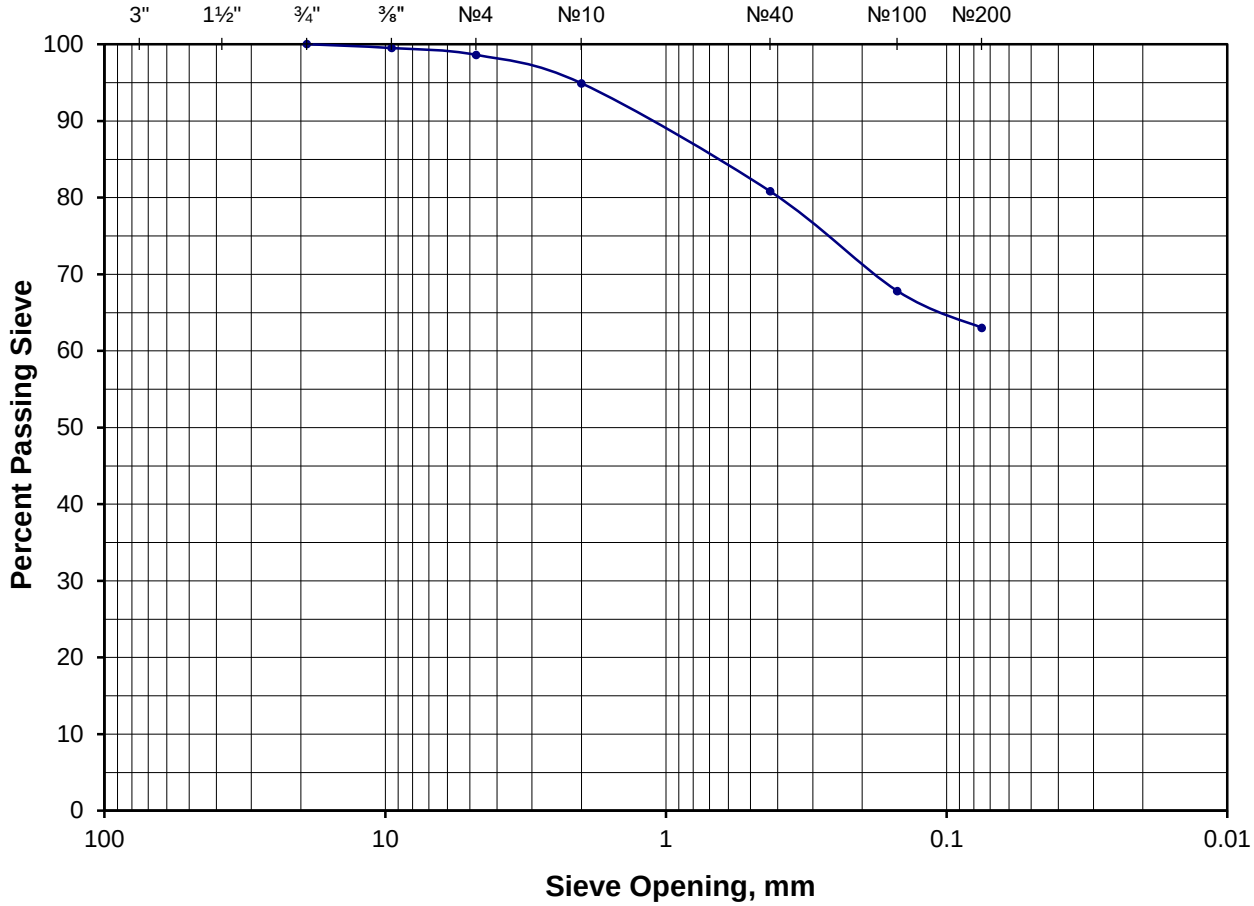
PIT NO.: TP-4
SHEET: 1 OF 1
START DATE: 1/23/25
END DATE: 1/23/25
SURFACE ELEV. (FT)

PROJECT NAME: Council Rock Chancellor Center
PROJECT LOCATION: Newtown Borough
PROJECT NUMBER: 39222.00
INSPECTOR NAME: J. D'Angelo
EQUIPMENT: Kubota U35-4
EXCAVATOR NAME/COMPANY: C. Carmint/Wayne Carmint Landscaping
WATER DEPTH: dry TIME: 0.5 hrs. DATE: 1/23/2025
CHECKED BY: D. Rude DATE: 03/04/26
WATER DEPTH: TIME: DATE:

DEPTH (FT)	USCS	H_2O CONTENT **	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
0.0	OH	M		Topsoil (8") 0.7	Easy Digging 0.0' to 4.0'
	SM	M		Silty Sand; some clay; brown, dark brown, gray (FILL) 4.0	
					Encountered unmarked buried utility at 4.0' Test Pit abandoned End of Test Pit at 4.0'

** D = DRY, M = MOIST, W = WET

Particle Size Analysis of Soils



As-rec'd water content: 21.0 moist	**Odor:** NR		
% Gravel: 1.4 **Coarse:** 0.0	**Fine:** 1.4		
% Sand: 35.6 **Coarse:** 3.7	**Medium:** 14.1	**Fine:** 17.8	
Gravel description: Brown to red-brown, subangular to subrounded			
Sand description: Brown to red-brown, subangular to subrounded			
Consistency: firm	**Hardness:** NR		
Cementation: NR	**Dry Strength:** NR		
Structure: homogeneous	**Dilatency:** NR		
Reaction to HCl: NR	**Toughness:** NR		
USCS Classification: CL, sandy lean clay			
AASHTO Classification: A-4			
Project: 39222.00 - Council Rock S.D. Chancellor Center INV			
Client: Council Rock School District			
Sample: B-1, S-2 (5-5-6-7), B-2, S-2 (5-5-5-6), & B-1, S-3 (5-5-5-7)			
Depth: 2.0'- 4.0' & 4.0'- 6.0'			
Description: Brown to red-brown sandy lean clay			
Remarks:			

Particle Size				
US Standard Sieve Size			Diameter	% Finer
GRAVEL	Coarse	3"	75	
		1½"	38.1	
		¾"	19.0	100.0
	Fine	⅜"	9.5	99.5
		№ 4	4.75	98.6
SAND	Coarse	№ 10	2.00	94.9
	Medium	№ 40	0.425	80.8
	Fine	№ 100	0.150	67.8
		№ 200	0.075	63.0
Hydrometer Analysis		Clay Size	0.005	NR
		Colloids	0.001	NR
G_s: NR	C_u: N/A	C_c: N/A		
LL: 30	**PL:** 20	**PI:** 10		

EARTH ENGINEERING INCORPORATE

Geotechnical Engineers & Geologists

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East Norriton, PA 19401
tel 610-277-0880 *fax* 610-277-0878

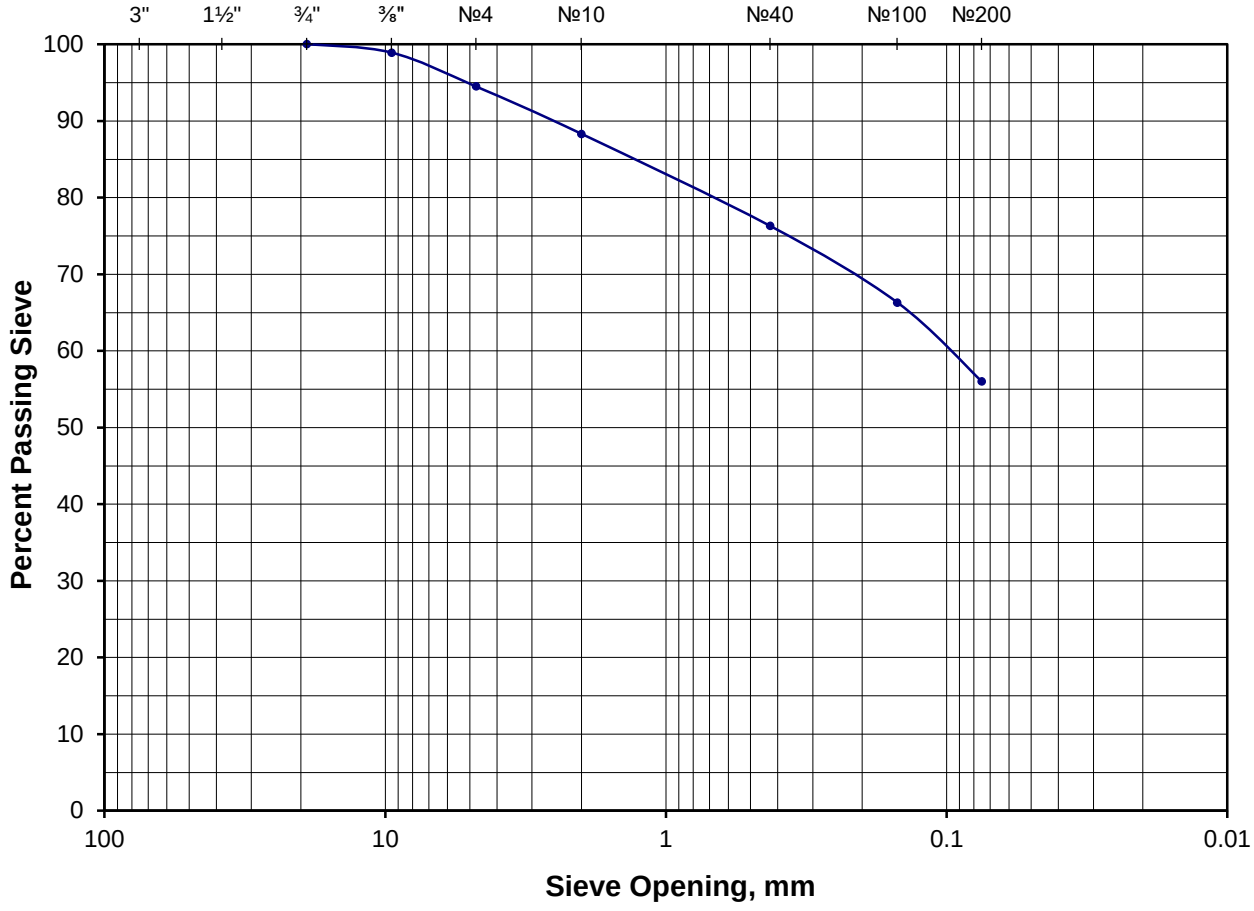
Southern NJ 856-768-1001

Central PA 717-697-5701

Lehigh Valley 610-967-4540

Classification of Soils, ASTM D 2487-17 / D 2488-09a ***January 6, 2026***

Particle Size Analysis of Soils



As-rec'd water content: 18.3 moist	**Odor:** NR		
% Gravel: 5.5 **Coarse:** 0.0	**Fine:** 5.5		
% Sand: 38.5 **Coarse:** 6.2	**Medium:** 12.0	**Fine:** 20.3	
Gravel description: Red-brown, subangular to subrounded			
Sand description: Red-brown, subangular to subrounded			
Consistency: firm	**Hardness:** NR		
Cementation: NR	**Dry Strength:** NR		
Structure: homogeneous	**Dilatency:** NR		
Reaction to HCl: NR	**Toughness:** NR		
USCS Classification: ML, sandy silt			
AASHTO Classification: A-4			
Project: 39222.00 - Council Rock S.D. Chancellor Center INV			
Client: Council Rock School District			
Sample: B-4, S-4 (20-19-20-15) & S-5 (50/5)			
Depth: 6.0'- 8.0' & 8.0'- 8.5'			
Description: Red-brown sandy silt			
Remarks:			

Particle Size				
US Standard Sieve Size			Diameter	% Finer
GRAVEL	Coarse	3"	75	
		1½"	38.1	
		¾"	19.0	100.0
	Fine	⅜"	9.5	98.9
		№ 4	4.75	94.5
SAND	Coarse	№ 10	2.00	88.3
	Medium	№ 40	0.425	76.3
	Fine	№ 100	0.150	66.3
		№ 200	0.075	56.0
Hydrometer Analysis		Clay Size	0.005	NR
		Colloids	0.001	NR
G_s: NR	C_u: N/A	C_c: N/A		
LL: NP	**PL:** NP	**PI:** NP		

EARTH ENGINEERING INCORPORATE

Geotechnical Engineers & Geologists

115 W Germantown Pk
East Norriton, PA 19401
tel 610-277-0880 *fax* 610-277-0878

Southern NJ
856-768-1001

Central PA
717-697-5701

Lehigh Valley
610-967-4540

Classification of Soils, ASTM D 2487-17 / D 2488-09a ***January 6, 2026***

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

March 6, 2026
EEI Project Nº: 39222.00

Christopher Peters, AIA
Principal Architect
Marotta Main Architects
214 Duke Street
Lancaster, PA 17602

Email: CRP@marottamain.com
Phone: 717-393-3211 x123

Re: Infiltration Investigation
Council Rock School District
Chancellor Center
30 N. Chancellor Street
Newtown, PA 18940

Dear Mr. Peters:

Earth Engineering Incorporated (EEI) has completed the infiltration investigation at the Council Rock School District – Chancellor Center. This letter presents the results of the infiltration testing.

EEI conducted infiltration testing on January 23, 2026. The test location is shown on the enclosed *Testing Location Plan*, EEI Drawing No. 39222.00-A-101. Infiltration testing was conducted within Test Pit 1 (TP-1) using the double ring infiltrometer (DRI) test method. The purpose of the DRI tests was to determine infiltration rates of the native soils at the site. The double ring infiltrometer has inner and outer rings measuring 4.0 and 8.0 inches, respectively. Procedures used for the infiltration testing were in general accordance with the *Pennsylvania Stormwater Best Management Practices (PA BMP) Manual, Appendix C*. The *Infiltration Testing Logs*, containing details of the double ring infiltration tests, are included with this letter report.

The following table summarizes the results of the infiltration testing performed at the site. Further detailed field-testing data is provided on the *Infiltration Testing Logs* included with this letter report. No precipitation was recorded during the 24 hours prior to testing. During the testing, the ambient temperature was approximately 34°F.

TABLE 1
INFILTRATION RATES AT TP-1
DOUBLE RING INFILTROMETER METHOD

Infiltration Test Number	1.) Ground Surface Elevation *(feet)*	Infiltration Test Depth *(feet)*	Infiltration Test Elevation *(feet)*	Test Interval *(minutes)*	Final Drop in Water Level *(inches)*	2.) Infiltration Rate *(inches/hour)*
DR-1A	1000.00	4.50	955.50	30	0.00	0.00
DR-1B	1000.00	4.50	955.50	30	0.00	0.00

1.) Ground surface elevation was avaiable at the time of this report, a placeholder of 1000.00 was used.
2.) The infiltration rates are field measured values and do not include a factor of safety for design purposes.

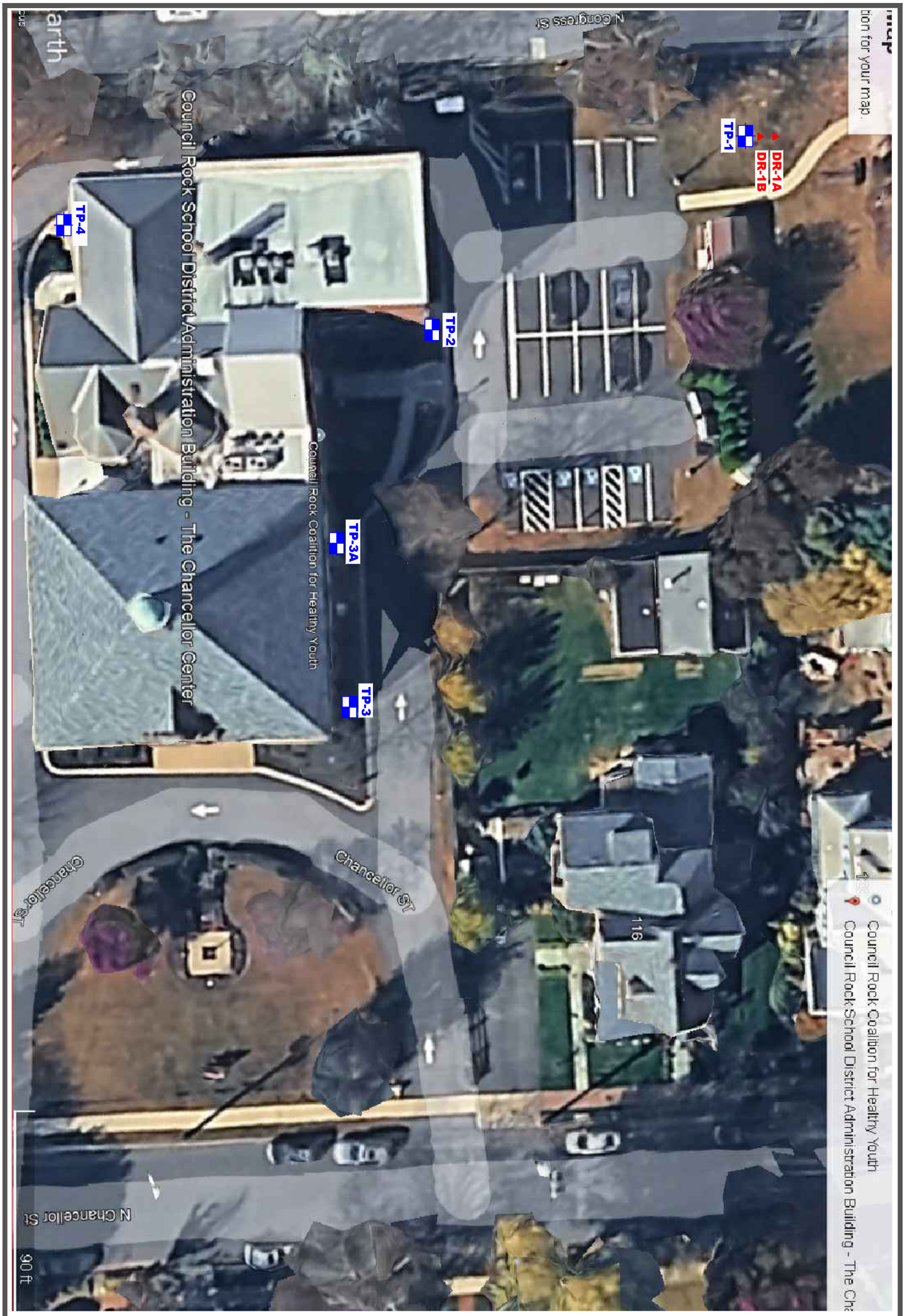
We appreciate the opportunity to be of continued service on this project. If you have any questions or require additional information, please contact the undersigned.

Respectfully submitted,
EARTH ENGINEERING INCORPORATED

John D'Angelo
Project Manager – Geotechnical Investigations

Patrick McNamara, P.E.
Director, Geotechnical Investigations

Enclosures: Testing Location Plan
Infiltration Testing Log



TEST PIT LOCATION PLAN

FOR

COUNCIL ROCK CHANCELLOR CENTER

NEWTOWN BOROUGH BUCKS COUNTY PENNSYLVANIA

Scale: NTS	Date: 1/28/2026	Drawn By: JAD	Checked By:
Drawing Number: 39222.00–A–101		Approved By:	

KEY:

- BORING LOCATION
- TEST PIT LOCATION
- INFILTRATION TEST LOCATION

BASE PLAN PROVIDED BY:

GOOGLE EARTH

EARTH ENGINEERING INCORPORATED

Geotechnical Engineers & Geologists

115 W. Germantown Pike
East Norriton, PA 19401
(610)277–0880
FAX (610)277–0878
www.earthengineering.com

Double Ring Infiltrometer Test Results

Location	Surface Elevation (ft.)	*Infiltration Depth (ft.)	Drop in Water within Inner Ring during Presoak Period (in.)		Drop in Water within Inner Ring at Time (in.)								**Infiltration Rate Inches/Hour
			30 min.	30 min.	30 min	30 min	30 min	30 min	min	min	min	min	
DR-1A	1000.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0					0.0
DR-1B	1000.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0					0.0

* Infiltration depths were measured from existing site grades at the time of the investigation.

Test Hole Number	Surface Elevation (ft.)	*Infiltration Depth (ft.)	Drop in Water within Inner Ring during Presoak Period (in.)		Drop in Water within Inner Ring at Time (in.)								**Infiltration Rate Inches/Hour
			30 min.	30 min.	30 min	30 min	30 min	30 min	30 min	30 min	30 min	30 min	

**Measured infiltration rates do not include a factor of safety for the design infiltration rate.

Indicates the final reading that was used to determine the infiltration rate at the corresponding location.

EARTH ENGINEERING INCORPORATED

Geotechnical Engineers & Geologists

115 West Germantown Pike East Norriton, PA 19401

PHONE 610-277-0880 FAX 610-277-0878

INFILTRATION TESTING LOG

Project Name: Council Rock Chancellor Center

Project Number: 39222.00

Date of Testing: 1/23/2026

EEI Representative: J. DeVita

Drawn/ Compiled by: J. DeVita

Date Compiled: 1/26/2026

SECTION 00 45 53 – CRIMINAL HISTORY BACKGROUND CHECK

PART 1 – GENERAL

1.1 PROCEDURES AND DOCUMENTS

A. The following is the background check information required by the PA Department of Education. This information, including fees should be verified on the following website:https://www.education.pa.gov/Educators/Clearances/Pages/default.aspx

B. All Contractor and Subcontractor employees engaged in Council Rock School District projects must have the following clearances pre-approved by the School District before being allowed on site.

C. Those required clearances and forms are as follows:

1. State Police Background Clearance (Required by PA Act 34)
   https://epatch.pa.gov

2. Federal Criminal History Record Information (CHRI) FBI Report
   (Required by PA Act 114)
   https://uenroll.identogo.com

   a) Service Code/ORI will be required by Owner
   - Council Rock School District service code is **1KG6XN**
   - Service Code is unique to your hiring/licensing agency. Do not use this code for another purpose.

3. Pennsylvania Child Abuse History Clearance (Required by Act 151)
   https://www.compass.state.pa.us/CWIS

4. An executed Arrest/Conviction Report and Certification Form (Act 82 and Act 24 Form).No Fee Required. (This is a written reporting of any arrests or convictions.) - Attached

5. An executed Sexual Misconduct/Abuse Disclosure Release Form (ACT 168 of 2014) No Fee Required. – Attached

D. Clearance forms must be submitted in their entirety to the Construction Manager, who will then in turn submit them to Council Rock School District.

E. **All clearance requirements must be completed for all employee's intended to work on the project site at any time during the project. Clearance requirements must be started upon Letter of Intent to Award Contractor. Completed documents must be submitted no later than Monday, January 4, 2027, for formal submission to and review by Council Rock School District.**

*All clearances must be valid for 1-year. No clearances will be accepted if clearances were completed beyond 1 years' time.

F. Council Rock School District will provide hard hat stickers to all workers who completed their background checks and are approved to work on the project site. Receival of hard hat stickers will be coordinated prior to start of the project.

END OF SECTION 00 45 53

COMMONWEALTH OF PENNSYLVANIA
SEXUAL MISCONDUCT/ABUSE DISCLOSURE RELEASE
(Pursuant to Act 168 of 2014)

Instructions

This standardized form has been developed by the Pennsylvania Department of Education, pursuant to Act 168 of 2014, to be used by school entities and independent contractors of school entities and by applicants who would be employed by or in a school entity in a position involving direct contact with children to satisfy the Act's requirement of providing information related to abuse or sexual misconduct. As required by Act 168, in addition to fulfilling the requirements under section 111 of the School Code and the Child Protective Services Law ("CPSL"), an applicant who would be employed by or in a school entity in a position having direct contact with children, must provide the information requested in SECTION 1 of this form and complete a written authorization that consents to and authorizes the disclosure by the applicant's current and former employers of the information requested in SECTION 2 of this form. The applicant shall complete one form for the applicant's current employer(s) and one for each of the applicant's former employers that were school entities or where the applicant was employed in a position having direct contact with children (therefore, the applicant may have to complete more than one form). Upon completion by the applicant, the hiring school entity or independent contractor shall submit the form to the applicant's current and former employers to complete SECTION 2. **A school entity or independent contractor may not hire an applicant who does not provide the required information for a position involving direct contact with children.**

Relevant Definitions:

Direct Contact with Children is defined as: "the possibility of care, supervision, guidance or control of children or routine interaction with children."

Sexual Misconduct is defined as: "any act, including, but not limited to, any verbal, nonverbal, written or electronic communication or physical activity, directed toward or with a child or a student regardless of the age of the child or student that is designated to establish a romantic or sexual relationship with the child or student. Such acts include, but are not limited to: (1) sexual or romantic invitation; (2) dating or soliciting dates; (3) engaging in sexualized or romantic dialogue; (4) making sexually suggestive comments; (5) self-disclosure or physical exposure of a sexual, romantic or erotic nature; or (6) any sexual, indecent, romantic or erotic contact with the child or student."

Abuse is defined as "conduct that falls under the purview and reporting requirements of the CPSL, 23 Pa.C.S. Ch. 63, is directed toward or against a child or a student, regardless of the age of the child or student."

Please Note

A prospective employer that receives any requested information regarding an applicant may use the information for the purpose of evaluating the applicant's fitness to be hired or for continued employment and shall report the information as appropriate to the Department of Education, a state licensing agency, law enforcement agency, child protective services agency, another school entity or to a prospective employer.

If the prospective employer decides to further consider an applicant after receiving an affirmative response to any of the questions listed in SECTIONS 1 and 2 of this form, the prospective employer shall request that former employers responding affirmatively to the questions provide additional information about the matters disclosed and include any related records. The **Commonwealth of Pennsylvania Sexual Misconduct/Abuse Disclosure Information Request** can be used to request this follow-up information. Former employers shall provide the additional information and records within 60 calendar days of the prospective employer's request.

The completed form and any information or records received shall not be considered public records for the purposes of the Act of February 14, 2008 (P.L. 6, No. 3) known as the "Right to Know Law."

The Department of Education shall have jurisdiction to determine willful violations of Act 168 and may, following a hearing, assess a civil penalty not to exceed $10,000. School entities shall be barred from entering into a contract with an independent contractor who is found to have willfully violated the provisions of Act 168.

COMMONWEALTH OF PENNSYLVANIA
SEXUAL MISCONDUCT/ABUSE DISCLOSURE RELEASE
(under Act 168 of 2014)

(Hiring school entity or independent contractor submits this form to ALL current employer(s) and to former employer(s) that were school entities and/or where the applicant had direct contact with children)

To:

Name of Current or Former Employer:		☐ No applicable employment
Street Address:		
City, State, Zip:		
Telephone Number:	Fax Number:	Email:
Contact Person:		Title:

The named applicant is under consideration for a position with our entity. The Pennsylvania General Assembly has determined that additional safeguards are necessary in the hiring of school employees to ensure the safety of the Commonwealth's students. The individual whose name appears below has reported previous employment with your entity. We request you provide the information requested in SECTION 2 of this form within **20 calendar days** as required by Act 168 of 2014.

SECTION 1: APPLICANT CERTIFICATION AND RELEASE (TO BE COMPLETED BY THE APPLICANT EVEN IF THE APPLICANT HAS NO CURRENT OR PRIOR EMPLOYMENT TO DISCLOSE)

Applicant's Name (First, Middle, Last):	
Any former names by which the Applicant has been identified:	
DOB:	
Last 4 digits of Applicant's Social Security Number:	PPID (if applicable):
Approximate dates of employment with the entity listed above:	
Position(s) held with the entity:	

Pursuant to Act 168, an employer, school entity, administrator, and/or independent contractor that provides information or records about a current or former employee or applicant shall be immune from criminal liability under the CPSL, the Educator Discipline Act, and from civil liability for the disclosure of the information, unless the information or records provided were knowingly false. Such immunity shall be in addition to and not in limitation of any other immunity provided by law or any absolute or conditional privileges applicable to such disclosure by the virtue of the circumstances of the applicant's consent thereto. Under Act 168, the willful failure to respond to or provide the information and records as requested may result in civil penalties and/or professional discipline, where applicable.

Have you (Applicant) ever:

Yes ☐ No ☐ Been the subject of an abuse or sexual misconduct investigation by any employer, state licensing agency, law enforcement agency or child protective services agency (unless the investigation resulted in a finding that the allegations were false)?

Yes ☐ No ☐ Been disciplined, discharged, non-renewed, asked to resign from employment, resigned from or otherwise separated from employment while allegations of abuse or sexual misconduct were pending or under investigation or due to adjudication or findings of abuse or sexual misconduct?

Yes ☐ No ☐ Had a license, professional license or certificate suspended, surrendered or revoked while allegations of abuse or sexual misconduct were pending or under investigation or due to an adjudication or findings of abuse or sexual misconduct?

By signing this form, I certify under penalty of law that the statements made in this form are correct, complete, and true to the best of my knowledge. I understand that false statements herein, including, without limitation, any willful failure to disclose the information required, shall subject me to criminal prosecution under 18 Pa.C.S. § 4904 (relating to unsworn falsification to authorities) and to discipline up to, and including, termination or denial of employment, and may subject me to civil penalties and disciplinary action under the Educator Discipline Act. I also hereby authorize the above-named employer to release to the entity listed on page 3, the information requested in SECTION 2 of this form and any related records. I hereby release, waive, and discharge the above-named employer from any and all liability of any kind that may arise from such disclosure or release of records. I understand that third party vendors may be used to process this Act 168 pre-employment history review.

_____ _____

Signature of Applicant Date

SECTION 2: CURRENT/FORMER EMPLOYER VERIFICATION (TO BE COMPLETED BY THE APPLICANT'S CURRENT EMPLOYER(S) AND ALL FORMER EMPLOYERS THAT WERE SCHOOL ENTITIES AND/OR WHERE THE APPLICANT HAD DIRECT CONTACT WITH CHILDREN)

Dates of employment of Applicant: _____ Contact telephone #:_____

To the best of your knowledge, has Applicant ever:

Yes ☐ No ☐ Been the subject of an abuse or sexual misconduct investigation by any employer, state licensing agency, law enforcement agency or child protective services agency (unless the investigation resulted in a finding that the allegations were false)?

Yes ☐ No ☐ Been disciplined, discharged, non-renewed, asked to resign from employment, resigned from or otherwise separated from employment while allegations of abuse or sexual misconduct were pending or under investigation or due to adjudication or findings of abuse or sexual misconduct?

Yes ☐ No ☐ Had a license, professional license or certificate suspended, surrendered or revoked while allegations of abuse or sexual misconduct were pending or under investigation or due to an adjudication or findings of abuse or sexual misconduct?

☐ No records or other evidence currently exists regarding the above questions. I have no knowledge of information pertaining to the applicant that would disqualify the applicant from employment.

_____ _____

Former Employer Representative Signature and Title Date

Return all completed information to:

School Entity/Independent Contractor:	
Address:	Phone:
City: State: Zip:	Fax: Email:
Contact Person:	Title:

Date Form Received: _____ Received by: _____

ARREST/CONVICTION REPORT AND CERTIFICATION FORM
(under Act 24 of 2011 and Act 82 of 2012)

Section 1. Personal Information

Full Legal Name: _____

Date of Birth: _____/_____/_____

Other names by which you have been identified: _____

Section 2. Arrest or Conviction

☐ By checking this box, I state that I have NOT been arrested for or convicted of any Reportable Offense.

☐ By checking this box, I report that I have been arrested for or convicted of an offense or offenses enumerated under 24 P.S. §§1-111(e) or (f.1) ("Reportable Offense(s)"). See Page 3 of this Form for a list of Reportable Offenses.

Details of Arrests or Convictions

For each arrest for or conviction of any Reportable Offense, specify in the space below (or on additional attachments if necessary) the offense for which you have been arrested or convicted, the date and location of arrest and/or conviction, docket number, and the applicable court.

_____

_____

Section 3. Child Abuse

☐ By checking this box, I state that I have NOT been named as a perpetrator of a founded report of child abuse within the past five (5) years as defined by the Child Protective Services Law.

☐ By checking this box, I report that I have been named as a perpetrator of a founded report of child abuse within the past five (5) years as defined by the Child Protective Services Law.

Section 4. Certification

By signing this form, I certify under penalty of law that the statements made in this form are true, correct and complete. I understand that false statements herein, including, without limitation, any failure to accurately report any arrest or conviction for a Reportable Offense, shall subject me to criminal prosecution under 18 Pa.C.S. §4904, relating to unsworn falsification to authorities.

_____

Signature *Date*

INSTRUCTIONS

Pursuant to 24 P.S. §1-111(c.4) and (j), the Pennsylvania Department of Education developed this standardized form (PDE-6004) to be used by current and prospective employees of public and private schools, intermediate units, and area vocational-technical schools.

As required by subsection (c.4) and (j)(2) of 24 P.S. §1-111, this form shall be completed and submitted by all current and prospective employees of said institutions to provide written reporting of any arrest or conviction for an offense enumerated under 24 P.S. §§1-111(e) and (f.1) and to provide notification of having been named as a perpetrator of a founded report of child abuse within the past five (5) years as defined by the Child Protective Services Law.

As required by subsection (j)(4) of 24 P.S. §1-111, this form also shall be utilized by current and prospective employees to provide written notice within seventy-two (72) hours after a subsequent arrest or conviction for an offense enumerated under 24 P.S. §§1-111(e) or (f.1).

In accordance with 24 P.S. §1-111, employees completing this form are required to submit the form to the administrator or other person responsible for employment decisions in a school entity. Please contact a supervisor or the school entity administration office with any questions regarding the PDE 6004, including to whom the form should be sent.

PROVIDE ALL INFORMATION REQUIRED BY THIS FORM LEGIBLY IN INK.

LIST OF REPORTABLE OFFENSES

- **A reportable offense enumerated under 24 P.S. §1-111(e) consists of any of the following:**

(1) An offense under one or more of the following provisions of Title 18 of the Pennsylvania Consolidated Statutes:

- Chapter 25 (relating to criminal homicide)
- Section 2702 (relating to aggravated assault)
- Section 2709.1 (relating to stalking)
- Section 2901 (relating to kidnapping)
- Section 2902 (relating to unlawful restraint)
- Section 2910 (relating to luring a child into a motor vehicle or structure)
- Section 3121 (relating to rape)
- Section 3122.1 (relating to statutory sexual assault)
- Section 3123 (relating to involuntary deviate sexual intercourse)
- Section 3124.1 (relating to sexual assault)
- Section 3124.2 (relating to institutional sexual assault)
- Section 3125(relating to aggravated indecent assault)
- Section 3126 (relating to indecent assault)
- Section 3127 (relating to indecent exposure)
- Section 3129 (relating to sexual intercourse with animal)
- Section 4302 (relating to incest)
- Section 4303 (relating to concealing death of child)
- Section 4304 (relating to endangering welfare of children)
- Section 4305 (relating to dealing in infant children)
- A felony offense under section 5902(b) (relating to prostitution and related offenses)
- Section 5903(c) or (d) (relating to obscene and other sexual materials and performances)
- Section 6301(a)(1) (relating to corruption of minors)
- Section 6312 (relating to sexual abuse of children)
- Section 6318 (relating to unlawful contact with minor)
- Section 6319 (relating to solicitation of minors to traffic drugs)
- Section 6320 (relating to sexual exploitation of children)

(2) An offense designated as a felony under the act of April 14, 1972 (P.L. 233, No. 64), known as "The Controlled Substance, Drug, Device and Cosmetic Act."

(3) An offense SIMILAR IN NATURE to those crimes listed above in clauses (1) and (2) under the laws or former laws of:

- the United States; or
- one of its territories or possessions; or
- another state; or
- the District of Columbia; or
- the Commonwealth of Puerto Rico; or
- a foreign nation; or
- under a former law of this Commonwealth.

- **A reportable offense enumerated under 24 P.S. §1-111(f.1) consists of any of the following:**

(1) An offense graded as a felony offense of the first, second or third degree, other than one of the offenses enumerated under 24 P.S. §1-111(e), if less than (10) ten years has elapsed from the date of expiration of the sentence for the offense.

(2) An offense graded as a misdemeanor of the first degree, other than one of the offenses enumerated under 24 P.S. §1-111(e), if less than (5) five years has elapsed from the date of expiration of the sentence for the offense.

(3) An offense under *75 Pa.C.S. § 3802(a)*, (b), (c) or (d)(relating to driving under influence of alcohol or controlled substance) graded as a misdemeanor of the first degree under *75 Pa.C.S. § 3803* (relating to grading), if the person has been previously convicted of such an offense and less than (3) three years has elapsed from the date of expiration of the sentence for the most recent offense.

IN THE COURT OF COMMON PLEAS
OF BUCKS COUNTY, PENNSYLVANIA
CIVIL DIVISION

CONTRACTOR: _____

NO. _____

AND
COUNCIL ROCK SCHOOL DISTRICT

NO-LIEN AGREEMENT

WHEREAS, the parties hereto did on the _____ day of _____, 20__, enter into an agreement (hereinafter the "Contract"), therein and whereby said Contractor undertook and agreed to furnish all materials, labor and equipment, etc., to complete the work for the Council Rock School District Chancellor Center Renovations, located at 30 North Chancellor Street, Newtown, PA 18940.

NOW, THEREFORE, the Contractor for itself and any and all subcontractors, materialmen and parties acting for, through or under the Contractor or for, through or under any of them, does covenant and agree that it will not at any time suffer or permit any mechanics' lien or any other lien, attachment or other encumbrance, under any laws, regulations, or orders, Federal, State or local, or otherwise by any person or persons whomsoever, to be put or remain on the building or premises, into or upon which any work is done or labor or materials are furnished under this Contract, for such work, labor or material, or by reason of any other claim or demand against the Contractor, and the Contractor has not obtained absolute title; and the Contractor agrees, further, that any mechanics' lien, materialmen's lien or any other lien, attachment or other encumbrance or claim of a third party, however arising (whether through the Contractor's or Owner's or any other persons action or inaction, and whether valid or invalid), until it is removed shall preclude any and all claim or demand for any payment whatsoever under or by virtue of the Contract, and in the event that same is not removed, the Owner at its discretion may remove same at the expense (including legal fees) of the Contractor, and without regard to the validity or invalidity thereof.

The Contractor expressly agrees further, that no lien shall attach to the real estate, building, structures, or any other improvement to the Owner either on behalf of the Contractor herein or on behalf of any subcontractor, mechanic, journeyman, laborer, materialman or person performing improvement or premises of said Owner, or on behalf of any other person. Neither the Contractor nor any other person supplying any materials, equipment, machinery or other property, or performing work or labor in or upon the building or the work, included in this Contract shall have the right to file a mechanic's lien against the building or premises.

Contractor warrants and represents that at the time of execution hereof no work of any kind has been done and no materials of any kind have been furnished, delivered or ordered in connection with the performance of this Contract of any supplemental contract for extra work.

This stipulation and waiver is made and intended to be filed with the Bucks County Prothonotary within ten (10) days after the date hereof, in accordance with the requirements of Act of Assembly of Pennsylvania, in such case provided.

In WITNESS WHEREOF, we have hereunto set our hands and seals, intending thereby to become legally bound this day of _____, 20____.

OWNER:
Council Rock School District

_____

_____

_____

ATTEST: _____ CONTRACTOR: _____

By: _____

WITNESS: _____

SECTION 00 70 00 - CONTRACT FOR CONSTRUCTION FORM OF AGREEMENT

The Standard Form of Agreement for this Contract is the American Institute of Architect's Document A132 “Standard Form of Agreement Between Owner and Contractor, Construction Manager as Advisor Edition”, 2019 Edition, is bound herewith.

The Contract shall be in effect for the duration of this project for all Contractors.

Document A132 is enclosed for each Prime Contractor’s review.

END OF SECTION 00 70 00

DRAFT

AIA® Document A132™ – 2019

Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition

AGREEMENT made as of the « » day of « » in the year « »
(In words, indicate day, month, and year.)

BETWEEN the Owner:
(Name, legal status, address, and other information)

«Council Rock School District»« »
«30 North Chancellor Street»
«Newtown, PA 18940»
«215-944-1000»

and the Contractor:
(Name, legal status, address, and other information)

« »« »
« »
« »
« »

for the following Project:
(Name, location, and detailed description)

«Chancellor Center Renovations»
«30 North Chancellor Street»
«Newtown, PA 18940»

The Construction Manager:
(Name, legal status, address, and other information)

«Boyle Construction, Inc.»« »
«3850 Sierra Circle, Suite 400»
«Center Valley, PA 18034»
«484-223-0726»

The Architect:
(Name, legal status, address, and other information)

«Marotta / Main Architects»« »
«214 North Duke Street»
«Lancaster, PA 17602»
« 717-393-3211»

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

This document is intended to be used in conjunction with AIA Documents A232™–2019, General Conditions of the Contract for Construction, Construction Manager as Adviser Edition; B132™–2019, Standard Form of Agreement Between Owner and Architect, Construction Manager as Adviser Edition; and C132™–2019, Standard Form of Agreement Between Owner and Construction Manager as Adviser. AIA Document A232™–2019 is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

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User Notes: (1936216363)

TABLE OF ARTICLES

1 THE CONTRACT DOCUMENTS

2 THE WORK OF THIS CONTRACT

3 DATE OF COMMENCEMENT AND DATES OF SUBSTANTIAL COMPLETION

4 CONTRACT SUM

5 PAYMENTS

6 DISPUTE RESOLUTION

7 TERMINATION OR SUSPENSION

8 MISCELLANEOUS PROVISIONS

9 ENUMERATION OF CONTRACT DOCUMENTS

EXHIBIT A INSURANCE AND BONDS
EXHIBIT B DETERMINATION OF THE COST OF THE WORK

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than Modifications, appears in Article 9. To the extent of any direct conflict or inconsistency between any of the Contract Documents, the Contractor shall immediately seek clarification from the Construction Manager. In the event that the Construction Manager fails to clarify such discrepancy, within a reasonable time under the circumstances, the Contractor shall proceed with the Work and give precedence to the Contract Documents in the following order of priority: (1) modifications issued after execution of the Agreement; (2) the Agreement; (3) Addenda issued prior to the execution of the Agreement, with the Addenda bearing the latest date taking precedence; (4) any supplementary conditions; (5) the General Conditions of the Contract for Construction; and (6) the Final Drawings and Specifications. The Contract Documents do not include soundings, dug test pits, and/or auger or test borings reports, or other information contained in geotechnical reports or similar documents.

ARTICLE 2 THE WORK OF THIS CONTRACT

§ 2.1 The Contractor shall fully execute the Work described in the Contract Documents as well as all attachments thereto and all work reasonably inferable by the Contract Documents as necessary to produce the results intended by the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others. A list of Contract Documents is attached hereto and incorporated herein as part of Exhibit "___."

§ 2.2 The Contractor shall furnish only skill and properly trained staff for the performance of the Work. The key members of the Contractor's staff shall be persons agreed upon by the Owner and identified in writing prior to the start of the Work. The Owner's authorized representative is set forth in section 14.3 below.

§ 2.2.1 Such key members of the Contractor's staff shall not be changed without the written consent of the Owner, unless such person becomes unable to perform any required duties due to death, disability, transfer, or termination of employment with the Contractor. If a key member is no longer capable of performing, the Owner and the Contractor shall agree on a mutually acceptable substitute.

§ 2.2.2 During the performance of the Work, the Contractor shall keep competent key personnel, including, but not limited to, Project Manager, Project Engineer, and Superintendent, at the Project site, fully authorized to act on behalf of

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the Contractor. Notice from the Owner and/or Construction Manager to such key personnel shall be considered notice to the Contractor.

ARTICLE 3 DATE OF COMMENCEMENT AND DATES OF SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be:
(Check one of the following boxes.)

[« »] The date of this Agreement.

[« X »] A date set forth in a written notice to proceed issued by the Owner to the Contractor, or upon the receipt of the Building Permit, whichever is later.

[« »] Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

« »

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

§ 3.2 The Contract Time shall be measured from the date of commencement of the Work.

§ 3.3 Substantial Completion of the Project or Portions Thereof

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the date of Substantial Completion of the Work of all of the Contractors for the Project will be:
(Insert the date of Substantial Completion of the Work of all Contractors for the Project.)

«December 17, 2027 »

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work of all of the Contractors for the Project are to be completed prior to Substantial Completion of the entire Work of all of the Contractors for the Project, the Contractors shall achieve Substantial Completion of such portions by the following dates:

Portion of Work	Substantial Completion Date

§ 3.4 When the Work of this Contract, or any Portion Thereof, is Substantially Complete

§ 3.4.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall substantially complete the entire Work of this Contract:
(Check one of the following boxes and complete the necessary information.)

[« »] Not later than « » (« ») calendar days from the date of commencement of the Work.

[« »] By the following date: « »

§ 3.4.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work of this Contract are to be substantially complete prior to when the entire Work of this Contract shall be substantially complete, the Contractor shall substantially complete such portions by the following dates:

Portion of Work	Date to be substantially complete

§ 3.4.3 If the Contractor fails to substantially complete the Work of this Contract, or portions thereof, as provided in this Section 3.4, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

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ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be one of the following:
(Check the appropriate box.)

[«X »] Stipulated Sum, in accordance with Section 4.2 below

[« »] Cost of the Work plus the Contractor's Fee, in accordance with Section 4.3 below

[« »] Cost of the Work plus the Contractor's Fee with a Guaranteed Maximum Price, in accordance with Section 4.4 below

(Based on the selection above, complete Section 4.2, 4.3 or 4.4 below.)

§ 4.2 Stipulated Sum

§ 4.2.1 The Contract Sum shall be « » ($ « »), subject to additions and deductions as provided in the Contract Documents.

§ 4.2.2 Alternates

§ 4.2.2.1 Alternates, if any, included in the Contract Sum:

Item	Price

§ 4.2.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.
(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance

§ 4.2.3 Allowances, if any, included in the Contract Sum:
(Identify each allowance.)

Item	Price

§ 4.2.4 Unit prices, if any:
(Identify the item and state the unit price, and quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price per Unit ($0.00)

§ 4.3 Cost of the Work Plus Contractor's Fee without a Guaranteed Maximum Price

§ 4.3.1 The Cost of the Work is as defined in Exhibit B, Determination of the Cost of the Work.

§ 4.3.2 The Contractor's Fee:
(State a lump sum, percentage of Cost of the Work or other provision for determining the Contractor's Fee.)

« »

§ 4.3.3 The method of adjustment of the Contractor's Fee for changes in the Work:

« »

§ 4.3.4 Limitations, if any, on a Subcontractor's overhead and profit for increases in the cost of its portion of the Work:

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« »

§ 4.3.5 Rental rates for Contractor-owned equipment shall not exceed « » percent (« » %) of the standard rental rate paid at the place of the Project.

§ 4.3.6 Unit prices, if any:
(Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price per Unit ($0.00)

§ 4.3.7 The Contractor shall prepare and submit to the Construction Manager, within 14 days of executing this Agreement, a written Control Estimate for the Owner's review and approval. The Control Estimate shall include the items in Section B.1 of Exhibit B, Determination of the Cost of the Work.

§ 4.4 Cost of the Work Plus Contractor's Fee with a Guaranteed Maximum Price
§ 4.4.1 The Cost of the Work is as defined in Exhibit B, Determination of the Cost of the Work.

§ 4.4.2 The Contractor's Fee:
(State a lump sum, percentage of Cost of the Work or other provision for determining the Contractor's Fee.)

« »

§ 4.4.3 The method of adjustment of the Contractor's Fee for changes in the Work:

« »

§ 4.4.4 Limitations, if any, on a Subcontractor's overhead and profit for increases in the cost of its portion of the Work:

« »

§ 4.4.5 Rental rates for Contractor-owned equipment shall not exceed « » percent (« » %) of the standard rental rate paid at the place of the Project.

§ 4.4.6 Unit Prices, if any: (Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price per Unit ($0.00)

§ 4.4.7 Guaranteed Maximum Price
§ 4.4.7.1 The Contract Sum is guaranteed by the Contractor not to exceed « » ($ « »), subject to additions and deductions by Change Order as provided in the Contract Documents. This maximum sum is referred to in the Contract Documents as the Guaranteed Maximum Price. Costs which would cause the Guaranteed Maximum Price to be exceeded shall be paid by the Contractor without reimbursement by the Owner.

§ 4.4.7.2 Alternates
§ 4.4.7.2.1 Alternates, if any, included in the Guaranteed Maximum Price:

Item	Price

§ 4.4.7.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.
(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance

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§ 4.4.7.3 Allowances, if any, included in the Guaranteed Maximum Price:
(Identify each allowance.)

Item	Price

§ 4.4.7.4 Assumptions, if any, upon which the Guaranteed Maximum Price is based:
(Identify each assumption.)

« »

§ 4.4.8 To the extent that the Contract Documents are anticipated to require further development, the Guaranteed Maximum Price includes the costs attributable to such further development consistent with the Contract Documents and reasonably inferable therefrom. Such further development does not include changes in scope, systems, kinds and quality of materials, finishes, or equipment, all of which, if required, shall be incorporated by Change Order.

§ 4.4.9 The Owner shall authorize preparation of revisions to the Contract Documents that incorporate the agreed-upon assumptions contained in Section 4.4.7.4. The Owner shall promptly furnish such revised Contract Documents to the Contractor. The Contractor shall notify the Owner and Architect of any inconsistencies between the agreed-upon assumptions contained in Section 4.4.7.4 and the revised Contract Documents.

§ 4.5 Liquidated damages, if any:
(Insert terms and conditions for liquidated damages, if any, to be assessed in accordance with Section 3.4.)

« The Contractor acknowledges and recognizes that the Owner is entitled to full and beneficial use of the completed work following expiration of the Contract Time. The Contractor further acknowledges and agrees that if the Contractor fails to achieve Substantial Completion of the entire Work within the Contract Time, the Owner will sustain extensive damages and serious loss as a result of such failure. The exact amount of such damages will be extremely difficult to ascertain. Therefore, the Owner and Contractor agree as set forth in this section.

« If the Contractor fails to achieve Substantial Completion as set forth in Section 3.3.1 of this Agreement, as may be adjusted pursuant to the Contract Documents, the Owner shall be entitled to assess liquidated damages against the Contractor in the amount of $2,000.00 for General Construction Contract and $1,000.00 for all other Contracts for each and every day thereafter until Substantial Completion is achieved.

Nothing herein shall limit Owner's rights to suspend or terminate the Work or Contractor, nor any of Owner's other non-monetary rights set forth herein. The Owner and Contractor agree that actual damages incurred by the Owner as a result of the delay are difficult to calculate with specificity and that the foregoing Liquidated Damages represent a mutual good faith estimate of what the parties believe to be the amount of actual damages to be incurred by the Owner on account of the delay. The parties jointly agree and stipulate that the contractually agreed to liquidated damages set forth above are not a penalty.
»

§ 4.6 Other:
(Insert provisions for bonus, cost savings or other incentives, if any, that might result in a change to the Contract Sum.)

« »

ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Construction Manager by the Contractor, and Certificates for Payment issued by the Construction Manager and Architect, the Owner shall make progress payments on account of the Contract Sum, to the Contractor, as provided below and elsewhere in the Contract Documents. In addition to the other required items, each application for payment shall be accomplished by the following, all in form and substance satisfactory to the Owner and in compliance with applicable statutes of the jurisdiction in which the Project is located:

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.1 A current sworn statement from the Contractor setting forth all Subcontractors and any material suppliers with whom Contractor has subcontracted, the amount requested for any Subcontractor or material supplier in the Application for Payment and the amount to be paid to the Contractor from such progress payment, as well as a sworn statement from the Contractor establishing receipt of payment or satisfaction of the payment requested by the Contractor in the previous Application for Payment, if any;

.2 Duly executed releases of mechanics' and material suppliers' liens and claims from the Contractor and also Subcontractors, sub-subcontractors and suppliers establishing payment or satisfaction of the payment requested by the Contractor in the previous Application for Payment (See Exhibit "___"); and

.3 Such other information, documentation, and materials, as the Owner, Owner's Lender, or the title insurer may reasonably require.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

« On or before the 20th day of the month immediately preceding a month in which the Contractor will submit an Application for Payment, the Owner, the Architect, the Construction Manager and the Contractor shall meet to review a preliminary draft of such Application for Payment (hereinafter referred to as a "Pencil Draw") prepared by the Contractor. The Contractor shall revise the Pencil Draw in accordance with any objection or recommendation of the Owner, Construction Manager or the Architect. Such revised Pencil Draw shall be resubmitted by the Contractor to the Construction Manager as the Application for Payment due on the fifth (5th) day of the month immediately following the month in which the Pencil Draw was first amended. The Contractor shall also submit with each Application for Payment a written narrative describing the basis for any items set forth in the Application for Payment that does not conform to the instructions of the Owner, Construction Manager or the Architect in connection with any applicable Pencil Draw. »

§ 5.1.3 Provided that a "Pencil Draw" Application for Payment pursuant to Section 5.1.2 is received by the Construction Manager not later than the «20th » day of a month and the Application for Payment submitted by the fifth (5th) day of the following month as stated above, , the Owner shall make payment of the amount certified to the Contractor not later than the «last » day of the «same » month in which the Application for Payment is submitted. If an Application for Payment is received by the Construction Manager after the application date fixed above, payment of the amount certified shall be made by the Owner not later than «thirty» («30 ») days after the Construction Manager receives the Application for Payment. Contractor is only permitted to submit one Application for Payment per calendar month.

(Federal, state or local laws may require payment within a certain period of time.)

§ 5.1.4 Progress Payments Where the Contract Sum is Based on a Stipulated Sum

§ 5.1.4.1 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Construction Manager and Architect may require. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.4.2 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.4.3 In accordance with AIA Document A232™–2019, General Conditions of the Contract for Construction, Construction Manager as Adviser Edition, as amended and as set forth in the Project specifications and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.4.3.1 The amount of each progress payment shall first include:

.1 That portion of the Contract Sum properly allocable to completed Work, as determined by multiplying the percentage completion of each portion of the Work by the share of the total Contract Sum allocated to that portion of the Work in the schedule of values, less the retainage; and

.2 That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner and Owner's Lender, if any, suitably stored off the site at a location agreed upon in writing; and

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.3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

§ 5.1.4.3.2 The amount of each progress payment shall then be reduced by:

.1 The aggregate of any amounts previously paid by the Owner;
.2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A232–2019;
.3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;
.4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A232–2019; and
.5 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.5 Progress Payments Where the Contract Sum is Based on the Cost of the Work without a Guaranteed Maximum Price

§ 5.1.5.1 With each Application for Payment, the Contractor shall submit the cost control information required in Exhibit B, Determination of the Cost of the Work, along with payrolls, petty cash accounts, receipted invoices, or invoices with check vouchers attached, and any other evidence required by the Owner, Construction Manager or Architect to demonstrate that payments already made by the Contractor on account of the Cost of the Work equal or exceed progress payments already received by the Contractor, plus payrolls for the period covered by the present Application for Payment, less that portion of the payments attributable to the Contractor's Fee.

§ 5.1.5.2 Applications for Payment shall show the Cost of the Work actually incurred by the Contractor through the end of the period covered by the Application for Payment and for which the Contractor has made or intends to make actual payment prior to the next Application for Payment.

§ 5.1.5.3 In accordance with AIA Document A232-2019, General Conditions of the Contract for Construction, Construction Manager as Advisor Edition, as amended and as set forth in the Project specifications and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.5.3.1 The amount of each progress payment shall first include:

.1 The Cost of the Work as described in Exhibit B, Determination of the Cost of the Work;
.2 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified; and
.3 The Contractor's Fee computed upon the Cost of the Work described in the preceding Section 5.1.5.3.1.1 at the rate stated in Section 4.3.2; or if the Contractor's Fee is stated as a fixed sum in Section 4.3.2 an amount which bears the same ratio to that fixed-sum Fee as the Cost of the Work included in Section 5.1.5.3.1.1 bears to a reasonable estimate of the probable Cost of the Work upon its completion.

§ 5.1.5.3.2 The amount of each progress payment shall then be reduced by:

.1 The aggregate of any amounts previously paid by the Owner;
.2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A232–2019;
.3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;
.4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A232–2019;
.5 The shortfall, if any, indicated by the Contractor in the documentation required by Section 5.1.5.1 to substantiate prior Applications for Payment, or resulting from errors subsequently discovered by the Owner's auditors in such documentation; and
.6 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.5.4 The Owner, Construction Manager and Contractor shall agree upon a mutually acceptable procedure for review and approval of payments to Subcontractors and the percentage of retainage held on Subcontracts, and the Contractor shall execute subcontracts in accordance with those agreements.

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§ 5.1.5.5 In taking action on the Contractor's Applications for Payment, the Construction Manager and Architect shall be entitled to rely on the accuracy and completeness of the information furnished by the Contractor, and such action shall not be deemed to be a representation that (1) the Construction Manager and Architect have made a detailed examination, audit or arithmetic verification of the documentation submitted in accordance with Article 5 or other supporting data; (2) that the Construction Manager and Architect have made exhaustive or continuous on-site inspections; or (3) that the Construction Manager and Architect have made examinations to ascertain how or for what purposes the Contractor has used amounts previously paid on account of the Contract. Such examinations, audits and verifications, if required by the Owner, will be performed by the Owner's auditors acting in the sole interest of the Owner.

§ 5.1.5.6 Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.1.5.7 If final completion of the Work is materially delayed through no fault of the Contractor, then the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A232-2019.

§ 5.1.6 Progress Payments Where the Contract Sum is Based on the Cost of the Work with a Guaranteed Maximum Price

§ 5.1.6.1 With each Application for Payment, the Contractor shall submit payrolls, petty cash accounts, receipted invoices or invoices with check vouchers attached, and any other evidence required by the Owner, Construction Manager or Architect to demonstrate that payments already made by the Contractor on account of the Cost of the Work equal or exceed progress payments already received by the Contractor plus payrolls for the period covered by the present Application for Payment, less that portion of the progress payments attributable to the Contractor's Fee.

§ 5.1.6.2 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Guaranteed Maximum Price among: (1) the various portions of the Work; (2) any contingency for costs that are included in the Guaranteed Maximum Price but not otherwise allocated to another line item or included in a Change Order; and (3) the Contractor's Fee.

§ 5.1.6.2.1 The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Construction Manager and Architect may require. This schedule of values, unless objected to by the Owner, Architect, or Construction Manager shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.6.2.2 The allocation of the Guaranteed Maximum Price under this Section 5.1.6.2 shall not constitute a separate guaranteed maximum price for the Cost of the Work of each individual line item in the schedule of values.

§ 5.1.6.2.3 When the Contractor allocates costs from a contingency to another line item in the schedule of values, the Contractor shall submit supporting documentation to the Architect and Construction Manager.

§ 5.1.6.3 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment. The percentage of completion shall be the lesser of (1) the percentage of that portion of the Work which has actually been completed; or (2) the percentage obtained by dividing (a) the expense that has actually been incurred by the Contractor on account of that portion of the Work and for which the Contractor has made payment or intends to make payment prior to the next Application for Payment by (b) the share of the Guaranteed Maximum Price allocated to that portion of the Work in the schedule of values.

§ 5.1.6.4 In accordance with AIA Document A232-2019, General Conditions of the Contract for Construction, Construction Manager as Advisor Edition, as amended and as set forth in the Project specifications and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.6.4.1 The amount of each progress payment shall first include:

.1 That portion of the Guaranteed Maximum Price properly allocable to completed Work as determined by multiplying the percentage of completion of each portion of the Work by the share of the Guaranteed Maximum Price allocated to that portion of the Work in the most recent schedule of values;

.2 That portion of the Guaranteed Maximum Price properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction or, if approved

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in writing in advance by the Owner and Owner's Lender, if any, suitably stored off the site at a location agreed upon in writing;

.3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified; and

.4 The Contractor's Fee, computed upon the Cost of the Work described in the preceding Sections 5.1.6.4.1.1 and 5.1.6.4.1.2 at the rate stated in Section 4.4.2 or, if the Contractor's Fee is stated as a fixed sum in that Section, an amount that bears the same ratio to that fixed-sum fee as the Cost of the Work included in Sections 5.1.6.4.1.1 and 5.1.6.4.1.2 bears to a reasonable estimate of the probable Cost of the Work upon its completion.

§ 5.1.6.4.2 The amount of each progress payment shall then be reduced by:

.1 The aggregate of any amounts previously paid by the Owner;

.2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A232–2019;

.3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;

.4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A232–2019;

.5 The shortfall, if any, indicated by the Contractor in the documentation required by Section 5.1.6.1 to substantiate prior Applications for Payment, or resulting from errors subsequently discovered by the Owner's auditors in such documentation; and

.6 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.6.5 The Owner and the Contractor shall agree upon a mutually acceptable procedure for review and approval of payments to Subcontractors and the percentage of retainage held on Subcontracts, and the Contractor shall execute subcontracts in accordance with those agreements.

§ 5.1.6.6 In taking action on the Contractor's Applications for Payment, the Construction Manager and Architect shall be entitled to rely on the accuracy and completeness of the information furnished by the Contractor and such action shall not be deemed to be a representation that (1) the Construction Manager or Architect have made a detailed examination, audit, or arithmetic verification of the documentation submitted in accordance with Section 5.1.6.1 or other supporting data; (2) that the Construction Manager or Architect have made exhaustive or continuous on-site inspections; or (3) that the Construction Manager or Architect have made examinations to ascertain how or for what purposes the Contractor has used amounts previously paid on account of the Contract. Such examinations, audits, and verifications, if required by the Owner, will be performed by the Owner's auditors acting in the sole interest of the Owner.

§ 5.1.6.7 Except with the Owner's prior approval and the prior written approval of Owner's Lender, if any, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.1.6.8 If final completion of the Work is materially delayed through no fault of the Contractor, then the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A232-2019, General Conditions of the Contract for Construction, Construction Manager as Advisor Edition, as amended and as set forth in the Project specifications

§ 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to when the Work of this Contract is substantially complete, the Owner may withhold the following amount, as retainage, from the payment otherwise due:
(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)

« »Ten Percent (10%) of the Contract amount of completed work and stored materials.

§ 5.1.7.1.1 The following items are not subject to retainage:
(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

« »None.

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§ 5.1.7.2 Reduction or limitation of retainage, if any, shall be as follows:
(If the retainage established in Section 5.1.7.1 is to be modified prior to when the entire Work of this Contract is substantially complete, including modifications for completion of portions of the Work as provided in Section 3.4.2, insert provisions for such modifications.)

« If the Owner reduces the retainage requirements of this Agreement or releases any portion of retainage prior to the date specified in the Contract Documents, any such reduction or release of retainage, or portion thereof, shall not be a waiver of any of the Owner's rights to retainage in connection with other payments to the Contractor or any other right or remedy that the Owner has under the Contract Documents, at law or in equity. Furthermore, the Owner reserves the right to withhold retainage due to the existence of unresolved claims from the Contractor's Subcontractors, Suppliers or any lower tier sub-subcontractors or suppliers to the extent necessary to reasonably protect the Owner as determined in Owner's sole discretion. The retainage of trades that complete their work prior to Final Completion of the Project, such as, but not limited to, steel, concrete, caissons, curtain wall, earthwork, aluminum, glass, glazing, exterior panels, plank, etc. ("Early Trades") may be released in Owner's sole discretion upon final completion of all the Early Trade's work on the Project including any punch-list items.»

»

§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, when the Work of this Contract is substantially complete, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted when the Work of this Contract is substantially complete shall not include retainage as follows:
(Insert any other conditions for release of retainage when the Work of this Contract is substantially complete, or upon Substantial Completion of the Work of all Contractors on the Project or portions thereof.)

« »

§ 5.2 Final Payment
§ 5.2.1 Final Payment Where the Contract Sum is Based on a Stipulated Sum
§ 5.2.1.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

.1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A232–2019, and to satisfy other requirements, if any, which extend beyond final payment;
.2 the Contractor has submitted all necessary documentation required by the Contract Documents, as well as any reasonable requests for additional documentation made by the Owner or the Construction Lender, if any;
.3 the Contractor has submitted duly executed releases of mechanics' and material suppliers' liens and claims from the Contractor and also Subcontractors, sub-subcontractors and suppliers; and
.4 a final Certificate for Payment or Project Certificate for Payment has been issued by the Architect.

§ 5.2.1.2 The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the final Certificate for Payment or Project Certificate for Payment, or as follows:

« Furthermore, the Owner reserves the right to withhold Final Payment due to the existence of unresolved claims from the Contractor's Subcontractors, Suppliers or any lower tier sub-subcontractors or suppliers to the extent necessary to reasonably protect the Owner as determined in Owner's sole discretion. »

§ 5.2.2 Final Payment Where the Contract Sum is Based on the Cost of the Work with or without a Guaranteed Maximum Price
§ 5.2.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

.1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A232–2019, and to satisfy other requirements, if any, which extend beyond final payment;
.2 the Contractor has submitted a final accounting for the Cost of the Work, pursuant to Exhibit B, Determination of the Cost of the Work and a final Application for Payment;

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.3 the Contractor has submitted all necessary documentation required by the Contract Documents, as well as any reasonable requests for additional documentation made by the Owner or the Construction Lender, if any;

.4 the Contractor has submitted duly executed releases of mechanics' and material suppliers' liens and claims from the Contractor and also Subcontractors, sub-subcontractors and suppliers

.5 a final Certificate for Payment or Project Certificate for Payment has been issued by the Architect in accordance with Exhibit B, Determination of the Cost of the Work.

§ 5.2.2.2 The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the final Certificate for Payment or Project Certificate for Payment, or as follows:

« Furthermore, the Owner reserves the right to withhold Final Payment due to the existence of unresolved claims from the Contractor's Subcontractors, Suppliers or any lower tier sub-subcontractors or suppliers to the extent necessary to reasonably protect the Owner as determined in Owner's sole discretion. »

§ 5.3 Intentionally omitted.

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

The Architect will serve as Initial Decision Maker pursuant to Article 15 of AIA Document A232–2019, unless the parties appoint below another individual, not a party to this Agreement, to serve as Initial Decision Maker.
(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

« »
« »
« »
« »

§ 6.2 Binding Dispute Resolution

For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A232–2019, the method of binding dispute resolution shall be as follows:
(Check the appropriate box.)

[« »] Arbitration pursuant to Article 15 of AIA Document A232–2019.

[« X »] Litigation in a court of competent jurisdiction in the Bucks County Court of Common Pleas.

[« »] Other: *(Specify)*

« »

If the Owner and Contractor do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 Where the Contract Sum is a Stipulated Sum

§ 7.1.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A232–2019, General Conditions of the Contract for Construction, Construction Manager as Advisor Edition, as amended and as set forth in the Project specifications .

§ 7.1.1.1 If the Contract is terminated for the Owner's convenience in accordance with Article 14 of AIA Document A232–2019, General Conditions of the Contract for Construction, Construction Manager as Advisor Edition, as amended and as set forth in the Project specifications then the Owner shall pay the Contractor a termination fee as follows:
(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner's convenience.)

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«None »

§ 7.1.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A232–2019.

§ 7.2 Where the Contract Sum is Based on the Cost of the Work with or without a Guaranteed Maximum Price
§ 7.2.1 Termination
§ 7.2.1.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A232–2019, General Conditions of the Contract for Construction, Construction Manager as Advisor Edition, as amended and as set forth in the Project specifications

§ 7.2.1.2 Termination by the Owner for Cause
§ 7.2.1.2.1 If the Owner terminates the Contract for cause as provided in Article 14 of AIA Document A232–2019, the Owner shall then only pay the Contractor an amount as follows:

.1 Take the Cost of the Work incurred by the Contractor to the date of termination;
.2 Add the Contractor's Fee, computed upon the Cost of the Work to the date of termination at the rate stated in Section 4.3.2 or 4.4.2, as applicable, or, if the Contractor's Fee is stated as a fixed sum in that Section, an amount that bears the same ratio to that fixed-sum Fee as the Cost of the Work at the time of termination bears to a reasonable estimate of the probable Cost of the Work upon its completion;
.3 Subtract the aggregate of previous payments made by the Owner; and
.4 Subtract the costs and damages incurred, or to be incurred, by the Owner under Article 14 of AIA Document A232–2019, General Conditions of the Contract for Construction, Construction Manager as Advisor Edition, as amended and as set forth in the Project specifications

§ 7.2.1.2.2 When the Contract Sum is based on the Cost of the Work with a Guaranteed Maximum Price, if the Owner terminates the Contract for cause as provided in Article 14 of AIA Document A232-2019, General Conditions of the Contract for Construction, Construction Manager as Advisor Edition, as amended and as set forth in the Project specifications the amount, if any, to be paid to the Contractor under Article 14 of AIA Document A232-2019, General Conditions of the Contract for Construction, Construction Manager as Advisor Edition, as amended and as set forth in the Project specifications shall not cause the Guaranteed Maximum Price to be exceeded, nor shall it exceed the amount calculated in Section 7.2.1.2.1.

§ 7.2.1.2.3 The Owner shall also pay the Contractor fair compensation, either by purchase or rental at the election of the Owner, for any equipment owned by the Contractor that the Owner elects to retain and that is not otherwise included in the Cost of the Work under Section 7.2.1.2.1.1. To the extent that the Owner elects to take legal assignment of subcontracts and purchase orders (including rental agreements), the Contractor shall, as a condition of receiving the payments referred to in this Article 7, execute and deliver all such papers and take all such steps, including the legal assignment of such subcontracts and other contractual rights of the Contractor, as the Owner may require for the purpose of fully vesting in the Owner the rights and benefits of the Contractor under such subcontracts or purchase orders. All Subcontracts, purchase orders and rental agreements entered into by the Contractor will contain provisions allowing for assignment to the Owner as described above.

§ 7.2.1.3 Termination by the Owner for Convenience
If the Owner terminates the Contract for convenience in accordance with Article 14 of AIA Document A232–2019, then the Owner shall pay the Contractor a termination fee as follows:
(Insert the amount of or method for determining the fee, if any, payable to the Contractor following a termination for the Owner's convenience.)

«None »

§ 7.3 Suspension
The Work may be suspended by the Owner as provided in Article 14 of AIA Document A232–2019, General Conditions of the Contract for Construction, Construction Manager as Advisor Edition, as amended and as set forth in the Project specifications ; in such case, the Contract Sum and Contract Time shall be increased as provided in Article 14 of AIA Document A232–2019, General Conditions of the Contract for Construction, Construction Manager as Advisor Edition, as amended and as set forth in the Project specifications except that the term "profit" shall be understood to mean the Contractor's Fee as described in Section 4.3.2 or 4.4.2, as applicable, of this Agreement.

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ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A232–2019, General Conditions of the Contract for Construction, Construction Manager as Advisor Edition, as amended and as set forth in the Project specifications or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 The Owner's representative:
(Name, address, email address, and other information)

« »
« »
« »
« »
« »

§ 8.3 The Contractor's representative:
(Name, address, email address, and other information)

« »
« »
« »
« »
« »
« »

§ 8.4 Neither the Owner's nor the Contractor's representative shall be changed without ten days' prior notice to the other party.

§ 8.5 Insurance and Bonds

§ 8.5.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A132™–2019, Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition, as amended and as set forth in the Project specifications Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A132™–2019, as amended and as set forth in the Project specifications Exhibit A, and elsewhere in the Contract Documents.

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A232–2019, General Conditions of the Contract for Construction, Construction Manager as Advisor Edition, as amended and as set forth in the Project specifications, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:
(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

« »

§ 8.7 Relationship of the Parties

Where the Contract is based on the Cost of the Work plus the Contractor's Fee, with or without a Guaranteed Maximum Price, the Contractor accepts the relationship of trust and confidence established by this Agreement and covenants with the Owner to cooperate with the Architect and exercise the Contractor's skill and judgment in furthering the interests of the Owner; to furnish efficient business administration and supervision; to furnish at all times an adequate supply of workers and materials; and to perform the Work in an expeditious and economical manner consistent with the Owner's interests. The Owner agrees to furnish and approve, in a timely manner, information required by the Contractor and to make payments to the Contractor in accordance with the requirements of the Contract Documents.

§ 8.8 Other provisions:

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«**§ 8.8.1** The Contractor represents and warrants the following to the Owner (in addition to any other representations and warranties contained in the Contract Documents), as a material inducement to the Owner to execute this Agreement, which representations and warranties shall survive the execution and delivery of this Agreement, any termination of this Agreement, and the final completion of the Work:

.1 The Contractor is financially solvent, is able to pay all debts as they mature, and is possessed of sufficient working capital to complete the Work and perform all obligations hereunder;

.2 The Contractor is able to furnish the plant, tools, materials, supplies, equipment and the labor required to complete the Work and perform its obligations hereunder and has sufficient experience and competence to do so;

.3 The Contractor is authorized to do business in the state in which the Project is located and is properly licensed by all necessary governmental and public and qualified public authorities having jurisdiction over the Contractor and over the Work and the Project;

.4 The Contractor's execution of this Agreement and performance thereof is within the Contractor's duly authorized powers;

.5 The Contractor's duly authorized representative has visited the site of the Project, is familiar with the location conditions under which the Work is to be performed, and has correlated observations with the requirements of the Contract Documents; and

.6 The Contractor possesses a high level of experience and expertise in the business administration, construction, construction management, and superintendence on Projects of this size, complexity, and the nature of this particular Project and will perform the Work with the care, skill, and diligence of such a contractor.

§ 8.8.2 Employee Verification through E-Verify.
Contractor and its Subcontractors shall comply with the Construction Industry Employee Verification Act ("Act 75"). In accordance with Act 75, each "construction industry employer" who hires an employee on or after October 7, 2020 shall verify the employment eligibility of the employee through the E-Verify program operated by the Department of Homeland Security and shall keep a record of the verification for the duration of the employee's employment or three years, whichever is longer.

§ 8.8.3 The Contractor acknowledges that the Owner maybe financing the Work with a loan from the Lender. In order to perform under the Contract Documents, the Owner must comply with certain terms and conditions embodied in the Lender's construction loan agreement. The Contractor agrees to use its best efforts to comply with the requirements of the Lender that bear upon the performance of the Work. The Contractor shall also:

1. Make the site of the Work available at reasonable times for inspection by the Lender or the Lender's representatives;

2. Consent to execute all documents reasonably requested by the Owner in connection with the assignment of this Agreement and the Drawings and Specifications to the Lender for collateral purposes. Such assignment shall provide that the Contractor agrees that notwithstanding a default by the Owner under the provisions of this Agreement that would give the Contractor the right to terminate this Agreement, the Contractor will continue to perform its obligations hereunder (on the same terms and conditions as are set forth herein) for and on account of the Lender, if the Lender, in its sole discretion, decided to proceed with the Project; and

3. Promptly furnish the Owner with information, documents, and material that the Owner may reasonably request from time to time in order to comply with the requirements of the Lender.

§ 8.8.4 Notwithstanding anything to the contrary contained in this Agreement or in any of the other Contract Documents, neither the Owner, any partner of the Owner, nor any person or entity holding any interest in the Owner shall be personally liable, whether directly or indirectly, by reason of any default by the Owner in the performance of any of the obligations of the Owner under this Agreement, including, without limitation, the Owner's failure to pay the Contractor as required hereunder, and in the event of any such default, the Contractor hereby agrees to look solely to the Owner's interest in the property upon which the Project is situated to secure the performance in payment of all such obligations. From time to time, however, the Owner may elect to sell, lease, mortgage, or otherwise transfer any of the Owner's interest in any portion of the Project site, not including any part of the Project site covered by the Project itself ("Site Conveyance"). In connection with any Site Conveyance, the Contractor shall execute and deliver to the Owner and shall cause any Subcontractors to execute and deliver to the Owner such documents for the benefit of the Owner, any purchaser, and any title insurance company issuing title insurance a full and complete release of all mechanics' and materials suppliers' liens and rights, with respect to the property that is the subject of such Site Conveyance, together

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with such other documents as a title company may require to induce it to issue its policy of title insurance with respect to the Site Conveyance without requiring the Owner's indemnity against mechanics' and materials suppliers' liens. »

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

.1 AIA Document A132™–2019, Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition, as modified

.2 AIA Document A132™–2019, Exhibit A, Insurance and Bonds Exhibit

.3 AIA Document A232™–2019, General Conditions of the Contract for Construction, Construction Manager as Adviser Edition, as modified

.4 AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:
(Insert the date of the E203-2013 incorporated into this Agreement.)

« »

.5 Drawings

Number	Title	Date

.6 Specifications

Section	Title	Date	Pages

.7 Addenda, if any:

Number	Date	Pages

Portions of Addenda relating to bidding or proposal requirements are not part of the Contract Documents unless the bidding or proposal requirements are also enumerated in this Article 9.

.8 Other Exhibits:
(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

[« »] AIA Document A132™–2019, Exhibit B, Determination of the Cost of the Work

[« »] AIA Document E235™–2019, Sustainable Projects Exhibit, Construction Manager as Adviser Edition, dated as indicated below:
(Insert the date of the E235-2019 incorporated into this Agreement.)

« »

[« »] The Sustainability Plan:

Title	Date	Pages

[« »] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

.9 Other documents, if any, listed below:

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(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A232–2019 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)

«»

This Agreement is entered into as of the day and year first written above.

OWNER *(Signature)*	CONTRACTOR *(Signature)*
« »« »	« »« »
(Printed name and title)	*(Printed name and title)*

DRAFT

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DRAFT AIA® Document A132® – 2019 Exhibit A

Insurance and Bonds

This Insurance and Bonds Exhibit is part of the Agreement, between the Owner and the Contractor, dated the « » day of « » in the year « »
(In words, indicate day, month, and year.)

for the following PROJECT:
(Name and location or address)

«Chancellor Center Renovations»
«30 North Chancellor Street»
«Newtown, PA 18940»
« »

THE OWNER:
(Name, legal status, and address)

«Council Rock School District»
«30 North Chancellor Street»
«Newtown, PA 18940»

THE CONTRACTOR:
(Name, legal status, and address)

« »« »
« »

TABLE OF ARTICLES

A.1 GENERAL

A.2 OWNER'S INSURANCE

A.3 CONTRACTOR'S INSURANCE AND BONDS

A.4 SPECIAL TERMS AND CONDITIONS

ARTICLE A.1 GENERAL

The Owner and Contractor shall purchase and maintain insurance, and provide bonds, as set forth in this Exhibit. As used in this Exhibit, the term General Conditions refers to AIA Document A232™–2019, General Conditions of the Contract for Construction, Construction Manager as Adviser Edition, as amended and as set forth in the Project specifications.

ARTICLE A.2 OWNER'S INSURANCE

§ A.2.1 General

Prior to commencement of the Work, the Owner shall secure the insurance, and provide evidence of the coverage, required under this Article A.2 and, upon the Contractor's request, provide a copy of the property insurance policy or policies required by Section A.2.3. The copy of the policy or policies provided shall contain all applicable conditions, definitions, exclusions, and endorsements.

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

This document is intended to be used in conjunction with AIA Document A232™–2019, General Conditions of the Contract for Construction. Article 11 of A232™–2019 contains additional insurance provisions

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§ A.2.2 Liability Insurance
The Owner shall be responsible for purchasing and maintaining the Owner's usual general liability insurance.

§ A.2.3 Required Property Insurance
§ A.2.3.1 Unless this obligation is placed on the Contractor pursuant to Section A.3.3.2.1, the Owner shall purchase and maintain, from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located, property insurance written on a builder's risk "all-risks" completed value or equivalent policy form and sufficient to cover the total value of the entire Project on a replacement cost basis. The Owner's property insurance coverage shall be no less than the amount of the initial Contract Sum, plus the value of subsequent Modifications and labor performed and materials or equipment supplied by others. The property insurance shall be maintained until Substantial Completion and thereafter as provided in Section A.2.3.1.3, unless otherwise provided in the Contract Documents or otherwise agreed in writing by the parties to this Agreement. This insurance shall include the interests of the Owner, Contractor, Subcontractors, and Sub-subcontractors in the Project as insureds. This insurance shall include the interests of mortgagees as loss payees.

§ A.2.3.1.1 Causes of Loss. The insurance required by this Section A.2.3.1 shall provide coverage for direct physical loss or damage, and shall not exclude the risks of fire, explosion, theft, vandalism, malicious mischief, collapse, earthquake, flood, or windstorm. The insurance shall also provide coverage for ensuing loss or resulting damage from error, omission, or deficiency in construction methods, design, specifications, workmanship, or materials. Sub-limits, if any, are as follows:
(Indicate below the cause of loss and any applicable sub-limit.)

Causes of Loss	Sub-Limit

§ A.2.3.1.2 Specific Required Coverages. The insurance required by this Section A.2.3.1 shall provide coverage for loss or damage to false work and other temporary structures, and to building systems from testing and startup. The insurance shall also cover debris removal, including demolition occasioned by enforcement of any applicable legal requirements, and reasonable compensation for the Architect's, Construction Manager's, and Contractor's services and expenses required as a result of such insured loss, including claim preparation expenses. Sub-limits, if any, are as follows:
(Indicate below type of coverage and any applicable sub-limit for specific required coverages.)

Coverage	Sub-Limit

§ A.2.3.1.3 Unless the parties agree otherwise, upon Substantial Completion, the Owner shall continue the insurance required by Section A.2.3.1 or, if necessary, replace the insurance policy required under Section A.2.3.1 with property insurance written for the total value of the Project that shall remain in effect until expiration of the period for correction of the Work set forth in Section 12.2.2 of the General Conditions.

§ A.2.3.1.4 Deductibles and Self-Insured Retentions. If the insurance required by this Section A.2.3 is subject to deductibles or self-insured retentions, the Owner shall be responsible for all loss not covered because of such deductibles or retentions.

§ A.2.3.2 Occupancy or Use Prior to Substantial Completion. The Owner's occupancy or use of any completed or partially completed portion of the Work prior to Substantial Completion shall not commence until the insurance company or companies providing the insurance under Section A.2.3.1 have consented in writing to the continuance of coverage. The Owner and the Contractor shall take no action with respect to partial occupancy or use that would cause cancellation, lapse, or reduction of insurance, unless they agree otherwise in writing.

§ A.2.3.3 Insurance for Existing Structures
If the Work involves remodeling an existing structure or constructing an addition to an existing structure, the Owner shall purchase and maintain, until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, "all-risks" property insurance, on a replacement cost basis, protecting the existing structure against direct physical loss or damage from the causes of loss identified in Section A.2.3.1, notwithstanding the undertaking of the Work. The Owner shall be responsible for all co-insurance penalties.

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§ A.2.4 Optional Extended Property Insurance.
The Owner shall purchase and maintain the insurance selected and described below.
(Select the types of insurance the Owner is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance. For each type of insurance selected, indicate applicable limits of coverage or other conditions in the fill point below the selected item.)

[« »] § A.2.4.1 Loss of Use, Business Interruption, and Delay in Completion Insurance, to reimburse the Owner for loss of use of the Owner's property, or the inability to conduct normal operations due to a covered cause of loss.

« »

[« »] § A.2.4.2 Ordinance or Law Insurance, for the reasonable and necessary costs to satisfy the minimum requirements of the enforcement of any law or ordinance regulating the demolition, construction, repair, replacement or use of the Project.

« »

[« »] § A.2.4.3 Expediting Cost Insurance, for the reasonable and necessary costs for the temporary repair of damage to insured property, and to expedite the permanent repair or replacement of the damaged property.

« »

[« »] § A.2.4.4 Extra Expense Insurance, to provide reimbursement of the reasonable and necessary excess costs incurred during the period of restoration or repair of the damaged property that are over and above the total costs that would normally have been incurred during the same period of time had no loss or damage occurred.

« »

[« »] § A.2.4.5 Civil Authority Insurance, for losses or costs arising from an order of a civil authority prohibiting access to the Project, provided such order is the direct result of physical damage covered under the required property insurance.

« »

[« »] § A.2.4.6 Ingress/Egress Insurance, for loss due to the necessary interruption of the insured's business due to physical prevention of ingress to, or egress from, the Project as a direct result of physical damage.

« »

[« »] § A.2.4.7 Soft Costs Insurance, to reimburse the Owner for costs due to the delay of completion of the Work, arising out of physical loss or damage covered by the required property insurance: including construction loan fees; leasing and marketing expenses; additional fees, including those of architects, engineers, consultants, attorneys and accountants, needed for the completion of the construction, repairs, or reconstruction; and carrying costs such as property taxes, building permits, additional interest on loans, realty taxes, and insurance premiums over and above normal expenses.

« »

§ A.2.5 Other Optional Insurance.
The Owner shall purchase and maintain the insurance selected below.
(Select the types of insurance the Owner is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance.)

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[« »] § A.2.5.1 Cyber Security Insurance for loss to the Owner due to data security and privacy breach, including costs of investigating a potential or actual breach of confidential or private information. *(Indicate applicable limits of coverage or other conditions in the fill point below.)*

« »

[« »] § A.2.5.2 Other Insurance
(List below any other insurance coverage to be provided by the Owner and any applicable limits.)

Coverage	Limits

ARTICLE A.3 CONTRACTOR'S INSURANCE AND BONDS

§ A.3.1 General

§ A.3.1.1 Certificates of Insurance. The Contractor shall provide certificates of insurance acceptable to the Owner evidencing compliance with the requirements in this Article A.3 at the following times: (1) prior to commencement of the Work; (2) upon renewal or replacement of each required policy of insurance; and (3) upon the Owner's written request. An additional certificate evidencing continuation of commercial liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment and thereafter upon renewal or replacement of such coverage until the expiration of the periods required by Section A.3.2.1 and Section A.3.3.1. The certificates will show the Owner as an additional insured on the Contractor's Commercial General Liability and excess or umbrella liability policy or policies.

§ A.3.1.2 Deductibles and Self-Insured Retentions. The Contractor shall disclose to the Owner any deductible or self- insured retentions applicable to any insurance required to be provided by the Contractor.

§ A.3.1.3 Additional Insured Obligations. To the fullest extent permitted by law, the Contractor shall cause the commercial general liability coverage to include (1) the Owner, the Architect and the Architect's consultants, and the Construction Manager and the Construction Manager's consultants, as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions for which loss occurs during completed operations. The additional insured coverage shall be primary and non-contributory to any of the Owner's general liability insurance policies and shall apply to both ongoing and completed operations. To the extent commercially available, the additional insured coverage shall be no less than that provided by Insurance Services Office, Inc. (ISO) forms CG 20 10 07 04, CG 20 37 07 04, and, with respect to the Architect and the Architect's consultants, and the Construction Manager and the Construction Manager's consultants, CG 20 32 07 04.

§ A.3.2 Contractor's Required Insurance Coverage

§ A.3.2.1 The Contractor shall purchase and maintain the following types and limits of insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, unless a different duration is stated below:
(If the Contractor is required to maintain insurance for a duration other than the expiration of the period for correction of Work, state the duration.)

« »

§ A.3.2.2 Commercial General Liability

§ A.3.2.2.1 Commercial General Liability insurance for the Project written on an occurrence form with policy limits of not less than «One Million Dollars » ($ «1,000,000 ») each occurrence, «Two Million Dollars » ($ «2,000,000 ») general aggregate, and «Two Million Dollars » ($ «2,000,000 ») aggregate for products-completed operations hazard, providing coverage for claims including

.1 damages because of bodily injury, sickness or disease, including occupational sickness or disease, and death of any person;

.2 personal injury and advertising injury;

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.3 damages because of physical damage to or destruction of tangible property, including the loss of use of such property;
.4 bodily injury or property damage arising out of completed operations; and
.5 the Contractor's indemnity obligations under Section 3.18 of the General Conditions.

§ A.3.2.2.2 The Contractor's Commercial General Liability policy under this Section A.3.2.2 shall not contain an exclusion or restriction of coverage for the following:

.1 Claims by one insured against another insured, if the exclusion or restriction is based solely on the fact that the claimant is an insured, and there would otherwise be coverage for the claim.
.2 Claims for property damage to the Contractor's Work arising out of the products-completed operations hazard where the damaged Work or the Work out of which the damage arises was performed by a Subcontractor.
.3 Claims for bodily injury other than to employees of the insured.
.4 Claims for indemnity under Section 3.18 of the General Conditions arising out of injury to employees of the insured.
.5 Claims or loss excluded under a prior work endorsement or other similar exclusionary language.
.6 Claims or loss due to physical damage under a prior injury endorsement or similar exclusionary language.
.7 Claims related to residential, multi-family, or other habitational projects, if the Work is to be performed on such a project.
.8 Claims related to roofing, if the Work involves roofing.
.9 Claims related to exterior insulation finish systems (EIFS), synthetic stucco or similar exterior coatings or surfaces, if the Work involves such coatings or surfaces.
.10 Claims related to earth subsidence or movement, where the Work involves such hazards.
.11 Claims related to explosion, collapse and underground hazards, where the Work involves such hazards.

§ A.3.2.3 Automobile Liability covering vehicles owned, and non-owned vehicles used, by the Contractor, with policy limits of not less than «One Million Dollars » ($ «1,000,000 ») per accident, for bodily injury, death of any person, and property damage arising out of the ownership, maintenance and use of those motor vehicles along with any other statutorily required automobile coverage.

§ A.3.2.4 The Contractor may achieve the required limits and coverage for Commercial General Liability and Automobile Liability through a combination of primary and excess or umbrella liability insurance, provided such primary and excess or umbrella insurance policies result in the same or greater coverage as the coverages required under Section A.3.2.2 and A.3.2.3, and in no event shall any excess or umbrella liability insurance provide narrower coverage than the primary policy. The excess policy shall not require the exhaustion of the underlying limits only through the actual payment by the underlying insurers.

§ A.3.2.5 Workers' Compensation at statutory limits.

§ A.3.2.6 Employers' Liability with policy limits not less than «One Hundred Thousand Dollars » ($ «100,000 ») each accident, «One Hundred Thousand Dollars » ($ «100,000 ») each employee, and «Five Hundred Thousand Dollars » ($ «500,000 ») policy limit.

§ A.3.2.7 Jones Act, and the Longshore & Harbor Workers' Compensation Act, as required, if the Work involves hazards arising from work on or near navigable waterways, including vessels and docks

§ A.3.2.8 If the Contractor is required to furnish professional services as part of the Work, the Contractor shall procure Professional Liability insurance covering performance of the professional services, with policy limits of not less than «One Million Dollars » ($ «1,000,000 ») per claim and «Two Million Dollars » ($ «2,000,000 ») in the aggregate.

§ A.3.2.9 If the Work involves the transport, dissemination, use, or release of pollutants, the Contractor shall procure Pollution Liability insurance, with policy limits of not less than « One Million Dollars » ($ « 1,000,000 ») per claim and « Two Million Dollars » ($ «2,000,000 ») in the aggregate.

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§ A.3.2.10 Coverage under Sections A.3.2.8 and A.3.2.9 may be procured through a Combined Professional Liability and Pollution Liability insurance policy, with combined policy limits of not less than « » ($ « ») per claim and « » ($ « ») in the aggregate.

§ A.3.2.11 Insurance for maritime liability risks associated with the operation of a vessel, if the Work requires such activities, with policy limits of not less than « » ($ « ») per claim and « » ($ « ») in the aggregate.

§ A.3.2.12 Insurance for the use or operation of manned or unmanned aircraft, if the Work requires such activities, with policy limits of not less than « » ($ « ») per claim and « » ($ « ») in the aggregate.

§ A.3.3 Contractor's Other Insurance Coverage

§ A.3.3.1 Insurance selected and described in this Section A.3.3 shall be purchased from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Contractor shall maintain the required insurance until the expiration of the period for correction of Work as set forth in Section 12.2.2 of the General Conditions, unless a different duration is stated below:
(If the Contractor is required to maintain any of the types of insurance selected below for a duration other than the expiration of the period for correction of Work, state the duration.)

«Umbrella Liability or Excess Liability – Two Million Dollars ($2,000,000.00) each occurrence. Two Million Dollars ($2,000,000.00) general aggregate. Two Million Dollars ($2,000,000.00) Products and Completed Operations Aggregate. Two Million Dollars ($2,000,000.00) - Personal and Advertising Injury »

§ A.3.3.2 The Contractor shall purchase and maintain the following types and limits of insurance in accordance with Section A.3.3.1.
(Select the types of insurance the Contractor is required to purchase and maintain by placing an X in the box(es) next to the description(s) of selected insurance. Where policy limits are provided, include the policy limit in the appropriate fill point.)

[« »] § A.3.3.2.1 If there is only one Contractor performing the Work on the Project, property insurance of the same type and scope satisfying the requirements identified in Section A.2.3, which, if selected in this section A.3.3.2.1, relieves the Owner of the responsibility to purchase and maintain such insurance except insurance required by Section A.2.3.1.3 and Section A.2.3.3. The Contractor shall comply with all obligations of the Owner under Section A.2.3 except to the extent provided below. The Contractor shall disclose to the Owner the amount of any deductible, and the Owner shall be responsible for losses within the deductible. Upon request, the Contractor shall provide the Owner with a copy of the property insurance policy or policies required. The Owner shall adjust and settle the loss with the insurer and be the trustee of the proceeds of the property insurance in accordance with Article 11 of the General Conditions unless otherwise set forth below:
(Where the Contractor's obligation to provide property insurance differs from the Owner's obligations as described under Section A.2.3, indicate such differences in the space below. Additionally, if a party other than the Owner will be responsible for adjusting and settling a loss with the insurer and acting as the trustee of the proceeds of property insurance in accordance with Article 11 of the General Conditions, indicate the responsible party below.)

« »

[« »] § A.3.3.2.2 Railroad Protective Liability Insurance, with policy limits of not less than « » ($ « ») per claim and « » ($ « ») in the aggregate, for Work within fifty (50) feet of railroad property.

[« »] § A.3.3.2.3 Asbestos Abatement Liability Insurance, with policy limits of not less than « » ($ « ») per claim and « » ($ « ») in the aggregate, for liability arising from the encapsulation, removal, handling, storage, transportation, and disposal of asbestos-containing materials.

[« »] § A.3.3.2.4 Insurance for physical damage to property while it is in storage and in transit to the construction site on an "all-risks" completed value form.

[« »] § A.3.3.2.5 Property insurance on an "all-risks" completed value form, covering property owned by

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the Contractor and used on the Project, including scaffolding and other equipment.

[« »] § A.3.3.2.6 Other Insurance
(List below any other insurance coverage to be provided by the Contractor and any applicable limits.)

Coverage	Limits

§ A.3.4 Performance Bond and Payment Bond
The Contractor shall provide surety bonds, from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located, as follows:
(Specify type and penal sum of bonds.)

Type	Penal Sum ($0.00)
Payment Bond	«100% »
Performance Bond	«100% »

Payment and Performance Bonds shall be AIA Document A312™, Payment Bond and Performance Bond, or contain provisions identical to AIA Document A312™, current as of the date of this Agreement.

ARTICLE A.4 SPECIAL TERMS AND CONDITIONS
Special terms and conditions that modify this Insurance and Bonds Exhibit, if any, are as follows:

«Maintenance Bond in the amount of 15% for 18 Months »

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SECTION 00 72 26 - GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

The General Conditions of this Contract is the American Institute of Architect's Document A232 "General Conditions of the Contract for Construction, Construction Manager as Advisor Edition", 2019 Edition, is bound herewith.

The General Conditions shall be in effect for the duration of this project for all Contractors. Document A232 is enclosed for each Prime Contractor's review.

END OF SECTION 00 72 26

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AIA® Document A232™ – 2019

General Conditions of the Contract for Construction,
Construction Manager as Adviser Edition

for the following PROJECT:
(Name, and location or address)

«Chancellor Center Renovations»
«30 North Chancellor Street
Newtown, PA 18940»

THE CONSTRUCTION MANAGER:
(Name, legal status, and address)

«Boyle Construction, Inc.»
«3850 Sierra Circle, Suite 400»
«Center Valley, PA 18034»

THE OWNER:
(Name, legal status, and address)

«Council Rock School District»
«30 North Chancellor Street»
«Newtown, PA 18940»

THE ARCHITECT:
(Name, legal status, and address)

«Marotta / Main Architects»
«214 North Duke Street»
«Lancaster, PA 17602»

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

This document is intended to be used in conjunction with AIA Documents A132™–2019, Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition; B132™–2019, Standard Form of Agreement Between Owner and Architect, Construction Manager as Adviser Edition; and C132™–2019, Standard Form of Agreement Between Owner and Construction Manager as Adviser.

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents. The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Advertisement for Bids, Instructions to Bidders ,Addenda issued prior to execution of the Contract, other documents listed in the Agreement, such as the Contractor's executed Bid Form, Bid Bond, Agreement of Surety, Performance Bond, Payment Bond, and Non-Collusion Affidavit, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of addenda relating to bidding or proposal requirements.
§1.1.1.1 The Contractor is responsible to read the entire AIA A232-2019 General Conditions of the Contract for Construction as it has been modified from the original AIA Document A232-2019.

§ 1.1.2 The Contract. The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and the Construction Manager or the Construction Manager's consultants, (3) between the Owner and the Architect or the Architect's consultants, (4) between the Contractor and the Construction Manager or the Construction Manager's consultants, (5) between the Owner and a Subcontractor or Sub-subcontractor (6) between the Construction Manager and the Architect, or (7) except as provided in Article 6 of these General Conditions, between any persons or entities other than the Owner and Contractor. The Construction Manager and Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of their duties. Each Subcontractor, having received and reviewed the Contract Documents, as evidenced by its execution of a subcontract with the Contractor, agrees that these General Conditions have been incorporated in the Subcontractor's subcontract by reference and, to the extent such General Conditions conflict with the express provisions of the subcontract with respect to obligations Subcontractor may have to Owner, these General Conditions shall take precedence.

§ 1.1.2.1 Contractor acknowledges and warrants that it has closely examined all of the Contract Documents, that they are suitable and sufficient to enable the Contractor to complete the Work in a timely manner for the Contract Sum, and that they include all Work, whether or not shown or described, which reasonably may be inferred to be required or useful for the completion of the Work in full compliance with all applicable codes, laws, ordinances, regulations and/or requirements of any local, state, federal or other governmental agency.

§ 1.1.3 The Work. The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations, and further including any Subcontractor and Sub-subcontractor Work, material suppliers, and/or any other entity from whom the Contractor is responsible whether on or off the site of the Project. . The Work may constitute the whole or a part of the Project.

§ 1.1.3.1 The Work shall include, without limitation, the obligation of the Contractor to visit the Project site before submitting a Bid. Such site visit shall be for the purpose of familiarizing the Contractor with the conditions as they exist and the character of the operations to be carried on under the Contract Documents, including, without limitation, all existing site conditions, access to the site, and the physical characteristics of the site and surrounding areas.

§ 1.1.3.2 Nothing in these General Conditions shall be interpreted as imposing on either the Owner, Construction Manager or Architect, or their respective agents, employees, officers, directors or consultants, any duty, obligation or authority with respect to any items that are not intended to be incorporated into the completed Project, or that do not comprise the Work, including, but not limited to, the following: shoring, scaffolding; hoists; weatherproofing; or any temporary facility; or activity, since these are the sole responsibility of the Contractor.

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§ 1.1.4 The Project. The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by other Contractors, and by the Owner's own forces and Separate Contractors.

§ 1.1.5 Contractors. Contractors are persons or entities, other than the Contractor or Separate Contractors, who perform Work under contracts with the Owner that are administered by the Architect and Construction Manager. This includes all Prime Contractors who have mutual responsibility to each other.

§ 1.1.6 Separate Contractors. Separate Contractors are persons or entities who perform construction under separate contracts with the Owner not administered by the Architect and Construction Manager.

§ 1.1.7 The Drawings. The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

§ 1.7.1 The Drawings are diagrammatical and show the general arrangement and extent of the Work; exact locations and arrangements of parts shall be determined as the Work progresses and shall be subject to the Architect's approval. No extra compensation will be allowed due to conflicts, inconsistences, or discrepancies between actual dimensions and those indicated. The right is reserved by the Architect to make any reasonable change in local of equipment, ductwork and piping prior to roughing in without involving additional compensation to the Prime Contractors. Each Prime Contractor shall coordinate its Work with the Work of others, so that interference between trades does not occur. Each Prime Contractor shall furnish and install offsets, bends, turns, and the like in connection with its Work to avoid interference with Work of other Contractors, to conceal Work where required, and to secure necessary clearance and access for operation and maintenance.

§ 1.1.7.2 Contractor shall carefully examine the Architectural, Mechanical, Plumbing, Electrical, Fire Protection, and other Contract Drawings and Specifications. If any discrepancies occur between the Drawings or between the Drawings and Specifications, the Contractor shall report such discrepancies to the Architect and Construction Manager in writing and obtain written instructions as to the manner in which to proceed. No departures from the Contract Documents shall be made without prior approval of the Architect and Construction Manager.

§ 1.1.8 The Specifications. The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.9 Instruments of Service. Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.10 Initial Decision Maker. The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

§ 1.1.11 Resident Project Engineer: The term Construction Manager (CM) shall refer to Boyle Construction, Inc.

§ 1.1.12 Owner: The term Owner shall refer to the Council Rock School District.

§ 1.1.13 Architect: The term Architect shall refer to Marotta / Main Architects and mean the registered Architect of record.

§ 1.1.14 Completion Date: The term Completion Date means any substantial completion, final completion, milestone, phase, or other time sensitive date identified in the Contract Documents.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by

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one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results. In the event of inconsistencies within or between parts of the Contract Documents, or between the Contract Documents and applicable standards, codes, and ordinances, the Contractor shall (i) provide the better quality or greater quantity of Work or (ii) comply with the more stringent requirement; either or both in accordance with the Architect's interpretation. The terms and conditions of this Sub-section 1.2.1, however, shall not relieve the Contractor of any of the obligations set forth in Sub-sections 3.2 and 3.7. Moreover, Work not expressly required in the Contract Documents will be required if it is consistent with the Contract Documents, is reasonably inferable from them as being necessary to produce the indicated results, is required by Article 2 of the Agreement, and to the extent it is necessary to produce complete and functioning Work.

§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade. Instructions and other information furnished in the Specifications, including, without limitation, items in connection with prefabricated or pre-finished items, are not intended to supersede work agreements between employers and employees. Should the Specifications conflict with such work agreements, the work agreements shall be followed, provided such items are provided and finished as specified. If necessary, such Work shall be performed on the Project site, instead of at the shop, by appropriate labor and in accordance with the requirements of the Drawings and Specifications.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings. Typographical and spelling errors shall be interpreted by the Architect for their obvious meaning and intent. References throughout the Contract Documents expressed in the singular number shall mean one or more like items as may be required to complete the Work. Likewise, plural references that obviously imply only one item shall mean only one item.

§ 1.2.4 Whenever a product is specified or shown by describing propriety items, model numbers, catalog numbers, manufacturer, trade names, or similar reference, no substitutions may be made unless accepted prior to execution of the Contract or if accepted as a Change in the Work. Where two or more products are shown or specified, the Contractor has the option to use either of those shown or specified.

§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice,

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if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Construction Manager and the Architect do not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work, and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract.

§ 2.2.2 {Intentionally omitted} Intentionally omitted.

§ 2.2.3 {Intentionally omitted} {Intentionally omitted}

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, or as otherwise indicated in the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities. Unless otherwise provided under the Contract Documents, the Owner, assisted by the Construction Manager, shall secure and pay for the building permit.

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§2.3.1.1 The Owner will secure and pay for the necessary zoning approvals, site development approvals, highway access approvals, design approvals, and other approvals related to permanent facilities and required precedent to applications for permits for Work at the Project site.

§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 The Owner shall retain a construction manager adviser lawfully practicing construction management in the jurisdiction where the Project is located. That person or entity is identified as the Construction Manager in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.4 If the employment of the Construction Manager or Architect terminates, the Owner shall employ a successor construction manager or architect to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Construction Manager or Architect, respectively.

§ 2.3.5 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.3.6 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.3.7 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.3.8 The Owner shall forward all communications to the Contractor through the Construction Manager. Other communication shall be made as set forth in Section 4.2.6.

§ 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to review by the Construction Manager and prior approval of the Architect, and the Construction Manager or Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Construction Manager's and Architect's and their respective consultants' additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15. The rights granted to the Owner pursuant to this Section 2.5 shall not give rise to any duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity.

§ 2.5.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents or project schedule, or fails to adequately staff the project with proper management, supervision, materials and Workforce, including its duty to proceed expeditiously with adequate forces so as to achieve substantial completion

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within the Contract Time, and fails within a seven (7) day period after receipt of written notice from the Owner to commence and continue correction of such default of neglect with diligence and promptness, the Owner may after such seven (7) day period give the Contractor a second written notice to correct such deficiencies within a three (3) day period. If the Contractor within such three (3) day period after receipt of such second notice fails to commence and continue to correct any deficiencies, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due to the Contractor the reasonable cost of correcting such deficiencies, including Owner's expenses, including attorney's fees and costs and compensation for the Architect's additional services made necessary by such default, neglect or failure. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. Notwithstanding the above, Owner shall not be required to comply the notice provisions hereof, and may proceed to correct deficiencies if Contractor fails within a 24-hour period after receipt of written notice form the Owner to commence and continue correction of such deficiencies where further delay would cause substantial disruption to the project schedule. Owner shall have the further right to carry out Work without any prior notice to Contractor, in an emergency affecting safety of persons or property, and said Work is necessary to prevent threatened damage, injury or loss. Owner's right in this regard shall not relieve Contractor of its obligations and responsibilities under the Contract Documents and shall not give rise to a duty on the part of the Owner to exercise the right for the benefit of the Contractor or any other person or entity.

§ 2.6 Owner's Representative

§ 2.6.1 The Owner reserves the right to employ a qualified person or firm as Owner's Representative or Clerk of the Works, to observe the Work in conjunction with the Architect or Construction Manager. Owner's Representative shall have the right to attend job conferences or project meetings and to come to the Project site while the Work is in progress. Owner's Representative shall observe the Work and report any defects or discrepancies in the Work to the Architect or Construction Manager. Nothing herein contained shall create any contractual relationship between Owner's Representative and any Contractor, Subcontractor or Sub-subcontractor. Owner's employment of a project representative or Clerk of the Works shall not relieve the Contractor of any of its responsibilities or obligations under the Contract Documents.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents. Where term "Contractor" is modified in any way, such as, without limit, "this Contractor", "General Construction Contractor", "Mechanical Contractor", "Plumbing Contractor, "Electrical Contractor", "separate contractor", the modified term shall be deemed to refer to the trade involved with the Work mentioned, but such meaning does not relieve the Contractor from his responsibility for all Work, whether or not such Work is sublet.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Construction Manager or Architect in their administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor. Observation of Work by the Construction Manager or Architect, or by their employees shall not be interpreted as relieving Contractor from his responsibility for coordination of all Work, his Superintendence of the Work, and his scheduling of the Work.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents. Prior to execution of the Agreement, the Contractor and each Subcontractor valued and satisfied themselves as to the conditions and limitations under which the Work is to

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be performed, including, without limitation, (i) the location, condition, layout, and nature of the Project site and surrounding areas, (ii) generally prevailing climatic conditions, (iii) anticipated labor supply and costs, (iv) availability and cost of materials, tools, and equipment and (v) other similar issues. The Owner assumes no responsibility or liability for the physical conditions or safety of the Project site of any improvements located on the Project site. The Owner shall not be required to make any adjustment in either the Contract Sum or the Contract Time in connection with any failure by the Contractor or any Subcontractor to have complied with the requirements of this Section 3.2.1. The Contractor shall review the drawings and Work of other separate contracts to determine if that Work affects the Contractor's planned Work.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.5, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Construction Manager and Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information submitted to the Construction Manager in such form as the Construction Manager and Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.2.1 The exactness of grades, elevations, dimensions, or locations given on any Contract Documents or the work installed by other contractors is not guaranteed by the Architect, the Construction Manager or the Owner. The Contractor shall, therefore, satisfy itself as to the accuracy of all grades, elevations, dimensions, and locations. In all cases of interconnection of its Work with existing or other work, it shall verify at the site all dimensions relating to such existing or other work. Any errors due to the Contractor's failure to so verify all such grades, elevations, dimensions, or locations shall be promptly rectified by the Contractor without any additional cost to the Owner.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Construction Manager and Architect any nonconformity discovered by or made known to the Contractor as a request for information submitted to Construction Manager in such form as the Construction Manager and Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities. The Contractor shall give the Architect, Construction Manager and Owner timely notice of any additional design drawings, specifications, or instructions required to define the Work in greater detail, or to permit the proper progress of the Work. The Contractor shall not proceed with any Work not clearly and consistently defined in detail in the Contract Documents, special requests, additional drawings or instructions from the Architect, Construction Manager and Owner. If the Contractor proceeds with such Work without obtaining further drawings or instruction, he shall correct Work incorrectly done at his own expense.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner, the Construction Manager, and the Architect, and shall propose alternative means, methods, techniques, sequences,

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or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. The Construction Manager shall review the proposed alternative for sequencing, constructability, and coordination impacts on the other Contractors. The Contractor shall not perform the Work using its alternative means, methods, techniques, sequences, or procedures and shall not proceed with that portion of the Work without further written instructions from the Architect, Construction Manager and Owner. If the Contractor fails to give the requisite written notice and proposed changes to the Owner, Construction Manager and Architect before proceeding with the applicable portion of the Work or if the Contractor gives the requisite notice and proposed changes and then proceeds with that portion of the Work prior to receiving further written instructions from the Architect, Construction Manager and Owner, then the Contractor shall be solely responsible for any resulting loss or damage. If the Contractor gives the requisite written notice and proposed changes and then is instructed by the Owner to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Owner shall be solely responsible for any loss or damage arising solely from those Owner-required means, methods, techniques, sequences or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of the Project already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.
If the Contractor desires to submit an alternate product or method in lieu of what has been specified or shown in the Contract Documents, the following provisions apply:

.1 The Contractor must submit to the Construction Manager (i) a full explanation of the proposed substitution and submittal of all supporting data, including technical information, catalog cuts, warranties, tests results, installation instructions, operating procedures and other like information necessary for a complete evaluation of the substitution; (ii) a written explanation of the reasons the substitution is advantageous and necessary, including the benefits to the Owner and the Work in the event the substitution is acceptable; (iii) the adjustment, if any, in the Contract Sum, in the event the substitution is acceptable; (iv) the adjustment, if any, in the time of completion of the Contract and the construction schedule in the event the substitution is acceptable; and (v) an affidavit stating that (a) the proposed substitution shown on the Drawings, and (b) the Contractor accepts the warranty and correction obligations in connection with the proposed substitution as if originally specified by the Architect. Proposals for substitution shall be submitted in triplicate to the Architect in sufficient time to allow the Architect no less than ten (10) working days for review. No substitutions will be considered or allowed without the Contractor's submittal of complete substantiating data and information as stated hereinbefore.

.2 Substitutions and alternates may be rejected without explanation and will be considered only under one or more of the following conditions: (i) the proposal is required for compliance with interpretation of code requirements or insurance regulations then existing; (ii) specified products are unavailable through no fault of the Contractor; (iii) subsequent information discloses the inability of specified products to perform properly or to fit in the designated space; (iv) the manufacturer/fabricator refuses to certify or guarantee the performance of the specified product as required; and (v) when in the judgment of the Owner, the Construction Manager or the Architect, a substitution would be substantially in the Owner's best interests, in terms of cost, time or other considerations.

.3 Whether or not any proposed substitution is accepted by the Owner, the Construction Manager or the Architect, the Contractor shall reimburse the Owner for any fees charged by the Construction Manager, the Architect or other consultants for evaluating each proposed substitute.

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§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect, in consultation with the Construction Manager, and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.4.4.1 The Contractor shall only employ or use labor in connection with the Work, capable of working harmoniously with all trades, crafts, and any other individuals associated with the Project. The Contractor shall also use best efforts to minimize the likelihood of any strike, work stoppage, or other labor disturbance.

§ 3.4.4.2 If the Work is to be performed by trade unions, the Contractor shall make all necessary arrangements to reconcile, without delay, damage or cost to the Owner and without recourse to the Architect or the Owner, any conflict between the Contract Documents and any agreements or regulations of any kind at any time in force among members or councils that regulate or distinguish the activities that shall not be included in the work of any particular trade.

§ 3.4.5 Whether indicated or not, all products included in the Work shall be asbestos-free and lead-free. If any suspected asbestos– containing or lead-containing materials are installed, the Owner has the right to have the material in question tested and if proven to contain asbestos or lead exceeding the amounts permitted by law, the Contractor shall remove all material in question and replace it with acceptable material at no additional cost to the Owner.

§ 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner, Construction Manager, and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Construction Manager or Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. The Contractor agrees to assign to the Owner at the time of final completion of the Work any and all manufacturer's warranties relating to materials and labor used in the Work and further agrees to perform the Work in such manner so as to preserve any and all such manufacturer's warranties.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4. The minimum Warranty period, as defined above shall be one (1) year from the date of Substantial Completion. The warranty provided in subparagraph 3.5.1 shall be in addition to and not in limitation of any other warranty required by the Contract Documents as otherwise prescribed by law.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work or portions thereof provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect and shall comply with the following:

§ 3.6.1.1 Contractor shall be responsible for and shall pay all applicable sales, use, excise or other taxes required by law on all materials, tools, apparatus, equipment, fixtures, services, incidentals or otherwise which may be purchased or used in connection with the Work or portions thereof. The Contract Sum shall include all applicable taxes.

Notwithstanding the foregoing, however, Owner is exempt (excluded) from sales and/or use tax in Pennsylvania on certain transactions. Contractor and all Subcontractors shall purchase as exempt (excluded) from Pennsylvania sales and/or use tax all tangible personal property within the definition of 'building machinery and equipment' as that

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term is defined in Act No. 45-1998 (72 P.S. § 7201 et seq.). No charges shall be allowed for such exempt items. It shall be the Contractor's responsibility to determine those items for which an exemption will apply, and the Contractor shall obtain legal or other tax advice to determine how and to what extent an exemption from the taxes apply. In order to facilitate such purchase free of sales and/or use tax in Pennsylvania, and upon certification by Contractor that an item is, in fact, tax exempt, the Owner agrees to execute a tax exemption certificate certification prepared by Contractor or a Subcontractor as may be required by the regulations of the Pennsylvania Department of Revenue.

3.6.1.2 Assignment of Refund Rights.
Owner shall be entitled to claim refunds of sales and/or use tax paid on these and other purchases of tangible personal property required in connection with the Work. The Contractor and all Subcontractors hereby assign to Owner all rights to any such refund claim and to any resulting refund and hereby appoint the Owner as their Attorney-in-Fact to execute and acknowledge in their respective names and to prosecute such refund claims before administrative agencies and courts in Pennsylvania having jurisdiction over such claims. The Owner or its agent shall have the right to review the books and records of the Contractor and all Subcontractors for the purpose of documenting and substantiating any such refund claim. Contractor and all Subcontractors shall cooperate fully with Owner in pursuing any such refund claim and shall make available to the Owner any applicable documents.

§ 3.6.1.3 Access to Accounting Records
The Contractor shall check all materials, equipment and labor entering into the Work, and shall keep such full and detailed accounts as may be necessary for proper financial management under the Contract and the system shall be satisfactory to Owner. The Owner or its representatives shall be afforded access to, including the right to photocopy, all the Contractor's records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to the Work, and the Contractor shall preserve all such records for a period of three (3) years, or for such longer period as may be required by the law, after receipt of final payment.

§ 3.6.1.4 Contracts with Subcontractors
The Contractor agrees to include the "Access to Accounting Records" and "Assignment of Refund Rights" paragraphs, in full, in any contracts with Subcontractors. The Contractor further agrees that it will not file a claim for refund for any sales and/or use tax which is subject of the assignment in Subparagraph 3.6.1.2 above. Contractor shall obtain from all Subcontractors similar agreements that they will not file claims for refund for any sales and/or use tax which is subject of the assignment as noted above.

§ 3.7 Permits, Fees, Notices, and Compliance with Laws
§ 3.7.1 Unless otherwise provided in the Contract Documents, the Owner, assisted by the Construction Manager, shall secure and pay for the building permit. The Contractor shall secure and pay for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded and shall provide proof by way of copies or certificates to the Construction Manager as soon as practicable. All connection charges, assessments, or inspection fees as may be imposed by any municipal agency or utility company are included in the Contract Sum and shall be the Contractor's responsibility. The Contractor shall also obtain and pay all charges for all approvals for street closings, parking meter removal, and other similar matters as may be necessary or appropriate from time to time for the performance of the Work.

§ 3.7.1.1 To the extent Contractor pays any permits, fees, including connection and/or tap-in fees not otherwise properly due, the Owner shall be entitled to any refund relating thereto and the Contractor agrees to assign any and all rights to said refund or refund claim to Owner. The Contractor and all Subcontractors hereby assign to Owner all rights to claim any such refund claim and to any resulting refund and hereby appoint the Owner as their Attorney-in-Fact to execute and acknowledge in their respective names and to prosecute such refund claims before administrative agencies and courts in Pennsylvania having jurisdiction over such claims. The Owner or its agent shall have the right to review the books and records of Contractor and all Subcontractors for the purpose of documenting and substantiating any such refund claim. Contractor and all Subcontractors shall cooperate fully with Owner in pursuing any such refund claim and shall make available to Owner any applicable documents.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

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§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions. If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner, Construction Manager, and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect and Construction Manager will promptly investigate such conditions and, if the Architect, in consultation with the Construction Manager, determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect, in consultation with the Construction Manager, determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner, Construction Manager, and Contractor, stating the reasons. If the Owner or Contractor disputes the Architect's determination or recommendation, either party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner, Construction Manager, and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents:

.1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;

.2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances;

.3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2;

.4 Upon execution of a Change Order addressing an item covered by an allowance, the allowance will be reduced by the value of the change order and the Contract Sum shall be adjusted accordingly to reflect the pricing in the Change Order; and

.5 The Contractor cannot bill for any Work associated with an allowance unless there is a signed executed Change Order for the Work.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work until the day of Substantial Completion, and for such additional time thereafter as the Architect, in consultation with the Construction Manager may determine to be necessary for the expeditious completion of the Work. The superintendent shall represent the Contractor, and communications

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given to the superintendent shall be as binding as if given to the Contractor. If, during the course of the project, it is evident that the superintendent is not competent, is not managing the progress of the Work, or is not coordinating the supervision of the various trades under the Contract, the Owner or Construction Manager may require the replacement of the superintendent with an acceptable superintendent.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect, through the Construction Manager, of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Construction Manager may notify the Contractor, stating whether the Owner, the Construction Manager, or the Architect (1) has reasonable objection to the proposed superintendent or (2) require additional time for review. Failure of the Construction Manager to provide notice within the 14-day period shall constitute notice of no reasonable objection. The Project Superintendent must be approved by the Owner, Architect, and Construction Manager prior to the start of Work. Within ten (10) days following receipt of Notice to Proceed, the Contractor shall submit a resume of the proposed Superintendent who will be on site full time. The resume shall include at least three (3) recent projects of similar contract scope with the names and telephone numbers of Owner and Architect representatives for each project. The Superintendent shall be on site full time and shall not be changed except with the Consent of the Owner, Architect, and Construction Manager, unless the Superintendent proves to be unsatisfactory to the Contractor and ceases to be in his employ. In any event, a replacement Superintendent shall be subject to the approval of the Owner, Architect, and Construction Manager.

§ 3.9.3 The Contractor shall not employ key personnel to whom the Owner, Construction Manager, or Architect has made reasonable and timely objection. The Contractor shall not change the key personnel without the Owner's consent, which shall not unreasonably be withheld or delayed. If, during the course of the Project, it is evident that any of the key personnel is not competent or is not managing the progress of the Work or is not coordinating the supervision of the various trades under the Contract, the Owner or Construction Manager may require the replacement of the personnel with acceptable personnel.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information, and the Construction Manager's use in developing the Project schedule, a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project. The Contractor shall cooperate with the Construction Manager in scheduling and performing the Contractor's Work to avoid conflict with, and as to cause no delay in, the work or activities of other Contractors, or the construction or operations of the Owner's own forces or Separate Contractors.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Construction Manager's and Architect's approval. The Architect and Construction Manager's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Construction Manager and Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall participate with other Contractors, the Construction Manager, and the Owner in reviewing and coordinating all schedules for incorporation into the Project schedule that is prepared by the Construction Manager. The Contractor shall make revisions to the construction schedule and submittal schedule as deemed necessary by the Construction Manager to conform to the Project schedule.

§ 3.10.4 The Contractor shall perform the Work in accordance with the most recent schedules submitted to the Owner, Construction Manager, and Architect, and incorporated into the approved Project schedule.

§ 3.10.5 The construction schedule shall be in a detailed precedence-style critical path management ("CPM") or primavera-type format satisfactory to the Owner and Construction Manager that shall also (i) provide a graphic

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representation of all activities and events that will occur during performance of the Work; (ii) identify each phase of construction and occupancy; and (iii) set forth dates that are critical in ensuring the timely and orderly completion of the Work in accordance with the requirements of the Contract Documents (hereinafter referred to as "Milestone Dates"). Upon review and acceptance by the Owner and Construction Manager of the Milestone Dates, the construction schedule shall be deemed part of the Contract Documents and attached to the Agreement as an Exhibit. If not accepted, the construction schedule shall be promptly revised by the Contractor in accordance with the recommendations of the Owner and the Construction Manager and resubmitted for acceptance. The Contractor shall monitor the progress of the Work for conformance with the requirements of the construction schedule and shall promptly advise the Owner of any delays or potential delays.

The accepted construction schedule shall be updated to reflect actual conditions as set forth in Section 3.10.1 or if requested by either the Owner or the Construction Manager. In the event any progress report indicates any delays, the Contractor shall propose an affirmative plan to correct the delay, including overtime and/or additional labor, if necessary. In no event shall any progress report constitute an adjustment in the Contract Time, any Milestone Date, or the Contract Sum unless any such adjustment is agreed to by the Owner and authorized pursuant to Change Order.

§ 3.10.6 In the event the Owner determines that the performance of the Work, as of a Milestone Date, has not progressed or reached the level of completion required by the Contract Documents, the Owner shall have the right to order the Contractor to take corrective measures necessary to expedite the progress of construction, including, without limitation, (i) working additional shifts or overtime; (ii) supplying additional manpower, equipment and facilities , and (iii) other similar measures (hereinafter referred to collectively as "Extraordinary Measures"). Such Extraordinary Measures shall continue until the progress of the Work complies with the stage of completion required by the Contract Documents. The Owner's right to require Extraordinary Measures is solely for the purpose of ensuring the Contractor's compliance with the construction schedule.

.1 The Contractor shall not be entitled to an adjustment in the Contract Sum in connection with Extraordinary Measures required by the Owner under or pursuant to this Section 3.10.6.

.2 The Owner may exercise the rights furnished the Owner under or pursuant to this Section 3.10.6 as frequently as the Owner deems necessary to ensure that the Contractor's performance of the Work will comply with any Milestone Date or completion date set forth in the Contract Documents.

§ 3.10.7 The Owner shall have the right to direct a postponement or reschedule of any date or time for the performance of any part of the Work that may interfere with the operation of the Owner's premises or any tenants or invitees thereof. The Contractor shall, upon the Owner's or Construction Manager's request, reschedule any portion of the Work affecting operation of the premises during hours when the premises are not in operation. Any postponement, rescheduling or performance of the Work under this Section 3.10.7 may be grounds for an extension of the Contract Time, if permitted, under Section 8.3.1, and an equitable adjustment in the Contract Sum if (i) the performance of the Work was properly scheduled by the Contractor in compliance with the requirements of the Contract

§ 3.10.8 If Contractor does not comply with all the above requirements and timelines, the Owner reserves the right to deduct $500.00 from the Contract amount for each day that Contractor does not comply. The aforesaid deduction shall be in the nature of liquidated damages and not a penalty as actual damages resulting from Contractor's failure to comply with the above requirements and timelines are impossible to determine. The Owner may also proceed with enforcing other requirements of the Contract Documents including Article 2.4.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Construction Manager, Architect, and Owner, and delivered to the Construction Manager for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.11.1 Monthly Report

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The Contractor shall record the progress of the Project. On a monthly basis (on the tenth (10th) day of each month), or otherwise as agreed to by the Owner or Construction manager, the Contractor shall submit written progress reports to the Owner, Construction Manager and Architect, showing percentages of completion and other information required by the Owner. Specifically, for the preceding thirty (30) days, Contractor shall submit to Owner and Construction Manger the current Project schedule, together with a monthly report, which shall include the following information:

1. a description of the work activity on the Project during the immediately preceding month;
2. a description of the work activity anticipated for the current month for each of the major trades;
3. a list of outstanding RFI's;
4. the status of change orders and anticipated change orders;
5. Project photographs;
6. a cost report;
7. an updated Project Schedule;
8. submittal log;
9. current Project directory;
10. contract schedule log;
11. change event log; and
12. procurement schedule.

§ 3.11.2 Daily Logs

The Contractor shall keep, and make available to the Owner, Construction Manager and Architect, a daily log containing a record for each day of weather, portions of the Work in progress, number of workers on site, identification of equipment on site, problems that might affect progress of the work, accidents, injuries, and other information required by the Owner.

§ 3.12 Shop Drawings, Product Data, and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect and Construction Manager is subject to the limitations of Sections 4.2.10 through 4.2.12. Informational submittals upon which the Construction Manager and Architect are not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Construction Manager or Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Construction Manager, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the Project submittal schedule approved by the Construction Manager and Architect or, in the absence of an approved Project submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of other Contractors, Separate Contractors, or the Owner's own forces. The Contractor shall cooperate with the Construction Manager in the coordination of the Contractor's Shop Drawings, Product Data, Samples, and similar submittals with related documents submitted by other Contractors.

§ 3.12.6 By approving and submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner, Construction Manager, and Architect, that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

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§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been reviewed and approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Construction Manager and Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Construction Manager and Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional and who shall comply with reasonable requirements of the Owner regarding qualifications and insurance. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner, the Architect, and the Construction Manager shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Construction Manager shall review submittals for sequencing, constructability, and coordination impacts on other Contractors.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Construction Manager and Architect at the time and in the form specified by the Architect.

§ 3.13 Use of Site

§ 3.13.1 The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.13.2 The Contractor shall coordinate the Contractor's operations with, and secure the approval of, the Construction Manager before using any portion of the site.

§ 3.13.3 Only materials and equipment that are to be used directly in the Work shall be brought to and stored on the Project site by the Contractor. After equipment is no longer required for the Work, it shall be promptly removed from the Project site. Protection of construction material and equipment stored at the Project site from weather, theft, damage and all other adversity is solely the responsibility of the Contractor. The Contractor shall ensure that the Work, at all times, is performed in a manner that affords reasonable access, both vehicular and pedestrian, to the site of the Work and all adjacent areas. The Work shall be performed, to the fullest extent reasonably possible, in such a

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manner that public areas adjacent to the site of the Work shall be free from all debris, building materials, and equipment likely to cause hazardous conditions.

§ 3.13.4 The Contractor and any entity for whom the Contractor is responsible shall not erect any sign on the Project site without the prior written consent of the Construction Manager, which may be withheld in the sole discretion of the Construction Manager.

§ 3.13.5 Without limitation of any other provision of the Contract Documents, the Contractor shall use best efforts to minimize any interference with the occupancy or beneficial use of (i) any areas of the buildings adjacent to the site of the Work and (ii) the project itself in the event of partial occupancy. Without prior approval of the Construction Manager, the Contractor shall not permit any workers to use any existing facilities at the Project site, including, without limitation, lavatories, toilets, entrances and parking areas other than those designated by the Construction Manager.

.1 Without limitation of any other provision of the Contract Documents, the Contractor shall use its best efforts to comply with all rules and regulations promulgated by the Owner or the Construction Manager in connection with the use and occupancy of the Project site and the building, as amended from time to time. The Contractor shall immediately notify the Construction Manager in writing if during the performance of the Work, the Contractor finds compliance of any portion of such rules and regulations to be impracticable, setting forth the problems of such compliance and suggesting alternatives through which the same results intended by such portions of the rules and regulations can be achieved. The Owner or Construction Manager may, in their sole discretion, adopt such suggestions, develop new alternatives or require compliance with the existing requirements of the rules and regulations.

.2 The Contractor shall also comply with all insurance requirements and collective bargaining agreements, if any, applicable to use and occupancy of the Project or any portion thereof.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner, Separate Contractors, or of other Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner, Separate Contractors, or by other Contractors except with written consent of the Construction Manager, Owner, and such other Contractors or Separate Contractors. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Separate Contractors, other Contractors, or the Owner, its consent to cutting or otherwise altering the Work.

§ 3.14.3 Patching of exposed Work shall only be performed by skilled workers of the required trade.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall keep the premises and surrounding area clean at all times of dirt, rubbish, waste materials and debris resulting from the Work and shall remove all rubbish, waste materials and debris in metal containers at the end of each Working day. The Contractor shall remove all rubbish cartons resulting from the installation of fixtures and equipment. If the premises are not kept clean at all times and if within 24 hours after verbal notice from the Owner the dirt, rubbish, waste materials and debris is not cleaned up by Contractor then Owner will arrange for such cleanup at the Contractor's expense. Prior to Substantial Completion of the Work the Contractor shall do the cleaning of the surfaces of all his installations as may be required by various Specifications to the satisfaction of the Architect and Construction Manager . At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project. In addition, the Contractor will be responsible for the proper disposal of such waste, in accordance with applicable law.

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§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner, or Construction Manager with the Owner's approval, may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.15.3 In readiness for occupancy of the Owner, the Contractor, when directed by the Architect or Construction Manager, shall thoroughly clean all portions of the Work to be occupied and all applicable material and equipment surfaces suitable for occupancy. Cleaning of windows and other glass in the Project is a contractual requirement.

§ 3.15.4 The General Contractor shall make provisions for and be personally responsible for removing all mud and debris from all vehicles and equipment leaving the construction site onto Municipal streets adjoining the Project site and shall remove any mud, debris and litter which may fall upon Municipal streets or adjacent properties. If the same is not removed and properly washed down within 24 hours after verbal notice from the Municipality or the Owner then in that event, said mud, debris and litter shall be removed from the street by the Owner at the Contractor's expense.

§ 3.16 Access to Work

The Contractor shall provide the Owner, Construction Manager, and Architect with access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner, Construction Manager, and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner, Architect, or Construction Manager. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect through the Construction Manager.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Construction Manager, Architect, Construction Manager's and Architect's consultants, any other entities identified in the Contract Documents, and agents and employees of any of them (individually, an "Indemnified Party," collectively, "Indemnified Parties") from and against any and all liabilities (including but not limited to contractual liabilities), claims (even if such claims are groundless, false or fraudulent), losses, damages, penalties, fines, settlements, costs, and/or expenses (including but not limited to court costs and reasonable attorneys' fees), attributable to injury (including but not limited to sickness, disease, or death) to any person (including but not limited to the Contractor's employees) and/or damage to any property of whatsoever kind or nature, arising out of or relating to the execution of the Work, or preparation for the Work, or any extension, modification, or amendment to the Work by change order or otherwise, or other directives from the Owner, or the design, manufacture, delivery, installation, use, misuse, maintenance, erection, repair, operation, or failure of any part, of all of the goods, materials, machinery, and/or equipment (even if such was furnished, rented, or loaned by any of the Indemnified Parties), even for, and if caused in part by, any negligent act or omission, or strict liability of an Indemnified Party. . Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

§ 3.18.3 The Contractor's obligation to defend the Indemnified Parties under this Section 3.18 is in addition to the Contractor's obligation to indemnify and hold harmless the Indemnified Parties. The Contractor shall, at the Contractor's expense, defend an Indemnified Party against any claim, whether asserted in a proceeding, action at law, in equity, in arbitration, or otherwise, containing any allegation(s) that may potentially give rise to the Contractor's obligation to indemnify an Indemnified Party under Sections 3.18.1 and 3.18.2 above. The Contractor

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shall retain an attorney to represent such Indemnified Party, provided, however, that any attorney employed in such defense must be satisfactory to the Indemnified Party. The Contractor's obligation to defend an Indemnified Party shall continue until such time as it is determined by court or arbitrator(s), through all appeals and/or the expiration of applicable appeal periods, that the Contractor is not obligated to provide such defense. The Contractor shall pay for all attorneys' fees and related legal expenses incurred by an Indemnified Party to enforce the Indemnified Party's rights under this Section 3.18.

§ 3.18.4 The Contractor's indemnity obligations under this Section I shall also specifically include, without limitation, all fines, penalties, damages, liability costs, expenses (including, without limitation, reasonable attorneys' fees), and punitive damages (if any) arising out of, or in connection with, any: (i) violation of or failure to comply with any law, statute, ordinance, rule, regulation, code or requirement of a public authority that relates to or bears upon the performance of the Work by the Contractor, its Subcontractors, or any person or entity for whom either is responsible, including, but not limited to, any environmental conditions, hazardous materials, or safety-related violation; (ii) means, methods, procedures, techniques, or sequences of execution or performance of the Work, (iii) failure to secure and pay for permits, fees, approvals, licenses and inspections as required under the Agreement, or any violation of any permit or other approval of a public authority applicable to the Work by the Contractor, its Subcontractors, or any person or entity for whom they are responsible, and (v) any patent or intellectual property infringement.

ARTICLE 4 ARCHITECT AND CONSTRUCTION MANAGER

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 4.1.2 The Construction Manager is the person or entity retained by the Owner pursuant to Section 2.3.3 and identified as such in the Agreement.

§ 4.1.3 Duties, responsibilities, and limitations of authority of the Construction Manager and Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Construction Manager, Architect, and Contractor. Consent shall not be unreasonably withheld.

§ 4.2 Administration of the Contract

§ 4.2.1 The Construction Manager and Architect will provide administration of the Contract as described in the Contract Documents and will be the Owner's representatives during construction until the date the Architect issues the final Certificate for Payment. The Construction Manager and Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. On the basis of the site visits, the Architect will keep the Owner and the Construction Manager reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner and Construction Manager known deviations from the Contract Documents and defects and deficiencies observed in the Work.

§ 4.2.2.1 The Owner is entitled to reimbursement from the Contractor for amounts paid to the Architect for site visits made necessary by the fault of the Contractor or by defects and deficiencies in the Work.

§ 4.2.3 The Construction Manager shall provide one or more representatives who shall be in attendance at the Project site whenever the Work is being performed. The Construction Manager will determine in general if the Work observed is being performed in accordance with the Contract Documents, will keep the Owner and Architect reasonably informed of the progress of the Work, and will promptly report to the Owner and Architect known deviations from the Contract Documents and the most recent Project schedule, and defects and deficiencies observed in the Work.

§ 4.2.4 The Construction Manager will schedule and coordinate the activities of the Contractor and other Contractors in accordance with the latest approved Project schedule.

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§ 4.2.5 The Construction Manager, except to the extent required by Section 4.2.4, and Architect will not have control over, charge of, or responsibility for, the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents, and neither will be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. Neither the Construction Manager nor the Architect will have control over or charge of, or be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or of any other persons or entities performing portions of the Work.

§ 4.2.6 Communications. The Owner shall communicate with the Contractor and the Construction Manager's consultants through the Construction Manager about matters arising out of or relating to the Contract Documents. The Owner and Construction Manager shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Construction Manager otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with other Contractors shall be through the Construction Manager. Communications by and with the Owner's own forces and Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 4.2.7 The Construction Manager and Architect will review and certify all Applications for Payment by the Contractor, in accordance with the provisions of Article 9.

§ 4.2.8 The Architect and Construction Manager have authority to reject Work that does not conform to the Contract Documents, and will notify each other about the rejection. Whenever the Construction Manager considers it necessary or advisable, the Construction Manager will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, upon written authorization of the Owner, whether or not the Work is fabricated, installed or completed. The foregoing authority of the Construction Manager will be subject to the provisions of Sections 4.2.18 through 4.2.20 inclusive, with respect to interpretations and decisions of the Architect. However, neither the Architect's nor the Construction Manager's authority to act under this Section 4.2.8 nor a decision made by either of them in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect or the Construction Manager to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons performing any of the Work.

§ 4.2.9 Utilizing the submittal schedule provided by the Contractor, the Construction Manager shall prepare, and revise as necessary, a Project submittal schedule incorporating information from other Contractors, the Owner, Owner's consultants, Owner's Separate Contractors and vendors, governmental agencies, and participants in the Project under the management of the Construction Manager. The Project submittal schedule and any revisions shall be submitted to the Architect for approval.

§ 4.2.10 The Construction Manager will receive and promptly review for conformance with the submittal requirements of the Contract Documents, all submittals from the Contractor such as Shop Drawings, Product Data, and Samples. Where there are other Contractors, the Construction Manager will also check and coordinate the information contained within each submittal received from the Contractor and other Contractors, and transmit to the Architect those recommended for approval. By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Construction Manager represents to the Owner and Architect that the Construction Manager has reviewed and recommended them for approval. The Construction Manager's actions will be taken in accordance with the Project submittal schedule approved by the Architect or, in the absence of an approved Project submittal schedule, with reasonable promptness while allowing sufficient time to permit adequate review by the Architect.

§ 4.2.11 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Upon the Architect's completed review, the Architect shall transmit its submittal review to the Construction Manager.

§ 4.2.12 Review of the Contractor's submittals by the Construction Manager and Architect is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for

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substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Construction Manager and Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Construction Manager and Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.13 The Construction Manager will prepare Change Orders and Construction Change Directives.

§ 4.2.14 The Construction Manager and the Architect will take appropriate action on Change Orders or Construction Change Directives in accordance with Article 7, and the Architect will have authority to order minor changes in the Work as provided in Section 7.4. The Architect, in consultation with the Construction Manager, will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.15 Utilizing the documents provided by the Contractor, the Construction Manager will maintain at the site for the Owner one copy of all Contract Documents, approved Shop Drawings, Product Data, Samples, and similar required submittals, in good order and marked currently to record all changes and selections made during construction. These will be available to the Architect and the Contractor, and will be delivered to the Owner upon completion of the Project.

§ 4.2.16 The Construction Manager will assist the Architect in conducting inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion in conjunction with the Architect pursuant to Section 9.8; and receive and forward to the Owner written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10. The Construction Manager will forward to the Architect a final Application and Certificate for Payment or final Project Application and Project Certificate for Payment upon the Contractor's compliance with the requirements of the Contract Documents.

§ 4.2.17 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Construction Manager of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.18 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of the Construction Manager, Owner, or Contractor through the Construction Manager. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.19 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions so rendered in good faith.

§ 4.2.20 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.21 The Construction Manager will receive and review requests for information from the Contractor, and forward each request for information to the Architect, with the Construction Manager's recommendation. The Architect will review and respond in writing, through the Construction Manager, to requests for information about the Contract Documents. The Construction Manager's recommendation and the Architect's response to each request will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in

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number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include other Contractors or Separate Contractors or the subcontractors of other Contractors or Separate Contractors.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 No later than 14 days subsequent to the full execution of this Agreement, the Contractor, shall notify the Construction Manager, for review by the Owner, Construction Manager and Architect, of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. The Owner reserves the right to deduct 500.00 from the Contract amount for each additional day past the 14- day period that all information is not furnished. The aforesaid deduction shall be in the nature of liquidated damages and not as a penalty as actual damages resulting from Contractor's failure to furnish the required information is impossible to determine. Within 14 days of receipt of the information, the Construction Manager may notify the Contractor whether the Owner, the Construction Manager or the Architect (1) has reasonable objection to any such proposed person or entity or, (2) requires additional time for review. Failure of the Construction Manager to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner, Construction Manager or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner, Construction Manager or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner, Construction Manager or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.3.1 No approval or disapproval by the Architect, Construction Manager or Owner of any particular Subcontractor shall relieve Contractor of its responsibility for performance of the Work. Furthermore, Contractor is not relieved of its responsibility for Contractor's selection of particular processes or materials for the performance of the Work by any Owner, Construction Manager or Architect approval of a particular Subcontractor.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner, Construction Manager or Architect makes reasonable objection to such substitution.

§ 5.2.5 The Contractor shall also require each Subcontractor to submit a list of any proposed sub-subcontractors and suppliers for Construction Manager's review and approval pursuant to the same process detailed in section 5.2.1 above, and Contractor shall not permit Subcontractor to delegate, or further subcontract to others the performance of any of its obligations or work required or contemplated by their Subcontract without prior written consent of the Construction Manager, which shall not be unreasonably withheld.

§ 5.2.6 Promptly upon execution of a subcontract, Contractor shall provide the Owner true, accurate and complete copies of all subcontracts and material supply contracts.

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, that the Contractor, by these Contract Documents, assumes toward the Owner, Construction Manager and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner, Construction Manager and Architect under the Contract Documents with respect to the Work to be performed by the

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Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.3.2 Where Contractor sublets portions of the Work, the entire responsibility for the subdividing of Work rests with the Contractor. The Owner, Architect, or Construction Manager are not responsible for the manner of the subdivision of the Work and none will enter into nor settle disagreements or disputes between Contractor and Subcontractors. The arrangement of Specifications and the manner of graphic illustration of Drawings are for convenience of reference and do not compromise any exacting method of subdividing Work for purposes of subcontracting, except where the Contract Documents require an undivided responsibility for certain Work.

§ 5.3.3 Contractor shall require each Subcontractor to (1) Inspect surfaces and job conditions before beginning Work at Project site, (2) Accept or cite necessary corrections in surfaces and job conditions before beginning Work at Project site, and (3) Protect his own materials, equipment and Work from damage, injury or loss due to weather or due to Work of the Contractor, other Subcontractors, or other Contractors. The best means of protection shall be supplied, and removed when no longer required.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

.1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and

.2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract (but only those arising post assignment).

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor Contractor or other entity. If the Owner assigns the subcontract to a successor Contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor Contractor's obligations under the subcontract.

§ 5.4.4 Each subcontract shall specifically provide that the Owner shall only be responsible to the Subcontractor for those obligations of the Contractor that accrue subsequent to the Owner's exercise of any rights under this conditional assignment.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction with Own Forces and to Award Other Contracts

§ 6.1.1 The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 6.1.2 When the Owner performs construction or operations with the Owner's own forces or Separate Contractors, the Contractor shall provide for coordination of such forces and Separate Contractors with the Work of the Contractor, who shall cooperate with them.

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§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner's own forces, Separate Contractors, Construction Manager and other Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner's own forces, Separate Contractors or other Contractors, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Construction Manager and Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor or other Contractors that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Construction Manager and the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's or other Contractors' completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractors or other Contractors that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs, including costs that are payable to a Separate Contractors or to other Contractors, because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of delays, improperly timed activities, damage to the Work or defective construction by the Owner's own forces, Separate Contractors, or other Contractors but, as to Separate Contractors or other Contractors, only to the extent Owner can recover such damages from the responsible Separate Contractors or other Contractors (such recovery being a condition precedent to the Owner's obligation to pay the Contractor for such costs).

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction, or to property of the Owner, Separate Contractors, or other Contractors as provided in Section 10.2.5.

§ 6.2.5 The Owner, Separate Contractors, and other Contractors shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.2.6 The Contractor shall indemnify and hold the Owner harmless from any claims or damages brought by a Separate Contractor or other Contractor arising out of actions or omissions of the Contractor, its Subcontractors or suppliers in performing their Work under the Contract Documents.

§ 6.2.7 Should the Contractor wrongfully cause damage to the Work or property of any Separate Contractor or other Contractor, the Contractor shall, upon due notice, promptly attempt to settle with the Separate Contractor or other Contractor by agreement, or otherwise to resolve the dispute. Such dispute shall not delay the completion of the Work. Work shall be continued by the Separate Contractor or other Contractor claiming damages at his expense subject to his right to recover damages. If such separate contractor or other Contractor sues the Owner, Architect or Construction Manager on account of any damage alleged to have been caused by the Contractor, the Owner, Architect or Construction Manager shall notify the Contractor who shall defend such proceedings at the Contractor's expense, and if any judgment or award against the Owner, Architect or Construction Manager arises therefrom the Contractor shall pay or satisfy it and shall reimburse the Owner, Architect or Construction Manager for all attorneys' fees and court costs which the Owner, Owner's Representative Architect or Construction Manager has incurred.

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, other Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Construction Manager, with notice to the Architect, will allocate the cost among those responsible.

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ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Construction Manager, Architect and Contractor. A Construction Change Directive requires agreement by the Owner, Construction Manager and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work. Except as permitted in Paragraph 7.3, a change in the Contract Sum or the Contract Time shall be accomplished only by Change Order. Accordingly, no course of conduct or dealings between the parties, nor express or implied, acceptance of alterations or additions to the Work, and no claim that Owner has been unjustly enriched by any alteration of or addition to the Work, whether or not there is, in fact, any unjust enrichment to the Work, shall be the basis of any claim to an increase in any amounts due under the Contract Documents or a change in any time period provided for in the Contract Documents.

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Construction Manager and signed by the Owner, Construction Manager, Architect, and Contractor, stating their agreement upon all of the following:

.1 The change in the Work;
.2 The amount of the adjustment, if any, in the Contract Sum; and
.3 The extent of the adjustment, if any, in the Contract Time.

§ 7.2.2 All Change Orders shall be accompanied by detailed price breakdowns in the format as directed by the Construction Manager. Owner reserves the right to accept or reject Contractor's price. No charges by Contractor for extra Work or changes in the Work shall be valid unless duly authorized pursuant to the procedures described herein. Written authority from the Construction Manager and Owner to perform extra Work or changes in the Work must be in the possession of the Contractor before such Work commences if Contractor seeks payment on account of such Work. Contractor agrees that prices for changes in the Work and for extra Work will not include charges involving penalties or damages for assumed delays in the Work, charges for estimating, cancellation charges on prior rejected work or similar amounts which do not relate directly to costs of labor and material and equipment necessary for the Work involved in the Change Order. Agreement on any Change Order shall constitute a final settlement of all matters relating to the change in the Work that is the subject of the Change Order, including, but not limited to, all direct and indirect costs associated with such change and any and all adjustments to the Contract Sum and the construction schedule.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Construction Manager and signed by the Owner, Construction Manager and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

.1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
.2 Unit prices stated in the Contract Documents or subsequently agreed upon;
.3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
.4 As provided in Section 7.3.4.

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§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Construction Manager shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Construction Manager may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

.1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Construction Manager and Architect;

.2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;

.3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;

.4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and

.5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Construction Manager of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Construction Manager and Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Construction Manager and Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Construction Manager and Architect determine to be reasonably justified. The interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Construction Manager and Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Construction Manager shall prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Construction Manager and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Construction Manager that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

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ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner, Architect, Construction Manager, or an employee of any of them, or of the Owner's own forces, Separate Contractors, or other Contractors; (2) by changes ordered in the Work; (3) by industry-wide labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts and the Architect, based on the recommendation of the Construction Manager, determines justify delay, then the Contract Time shall be extended to the extent such delay will prevent the Contractor from achieving Substantial Completion within the Contract Time and if the performance of the Work is not was not, or would not have been delayed by any other cause for which the Contractor is not entitled to an extension in the Contract Time under the Contract Documents. The Contractor further acknowledges and agrees that adjustment in the Contract Time will be permitted for a delay only to the extent such delay (i) is not caused, or could not have been anticipated, by the Contractor, (ii) could not be limited or avoided by the Contractor's timely notice to the Owner of the delay or reasonable likelihood that a delay will occur, and (iii) is of a duration of not less than one (1) day.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 Notwithstanding anything to the contrary in the Contract Documents, an extension in the Contract Time, to the extent permitted under Subparagraph 8.3.1 shall be the sole remedy of the Contractor for any (i) delay in the commencement, prosecution, or completion of the Work; (ii) hindrance or obstruction in the performance of the Work, (iii) loss of productivity or (iv) other similar claims (collectively referred to in this Subparagraph 8.3.3 as "Delays") whether or not such Delays are foreseeable, unless a Delay is caused by acts of the Owner constituting active interference with the Contractor's performance of the Work, and only to the extent such acts continue after the Contractor furnishes the Owner with notice of such interference. In no event shall the Contractor be entitled to any compensation or recovery of any damages, in connection with any Delay, including, without limitation, consequential damages, lost opportunity costs, impact damages, or other similar remuneration. The Owner's exercise of any of its rights or remedies under the Contract Documents (including, without limitation, ordering changes in the Work, or directing suspension, rescheduling or correction of the Work), regardless of the extent or frequency of the Owner's exercise of such rights or remedies, shall not be construed as active interference with the Contractor's performance of the Work.

§ 8.3.4 If the Contractor submits a progress report indicating or otherwise expresses an intention to achieve, completion of the Work prior to any completion date required by the Contract Documents, or expiration of the

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Contract Time, no liability of the Owner to the Contractor for any failure of the Contractor to so complete the Work shall be created or implied.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Construction Manager, earlier of fourteen (14) days of the execution of this Agreement or ten (10) days before the before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Construction Manager and the Architect. This schedule, unless objected to by the Construction Manager or Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. The Construction Manager shall forward to the Architect the Contractor's schedule of values. Any changes to the schedule of values shall be submitted to the Construction Manager and supported by such data to substantiate its accuracy as the Construction Manager and the Architect may require, and unless objected to by the Construction Manager or the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

§ 9.3 Applications for Payment

§ 9.3.1 At least fifteen days before the date established for each progress payment, unless otherwise required by the Agreement, the Contractor shall submit to the Construction Manager an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner, Construction Manager or Architect require, such as copies of requisitions, and releases of waivers of lien from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Construction Manager and Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.1.3 Each Application for Payment shall be accompanied by the following, all in form and substance satisfactory to the Construction Manager; (i) a current Contractor's lien waiver and duly executed and acknowledged sworn statement showing all Subcontractors and material suppliers with whom the Contractor has entered into subcontracts, the amount of each such subcontract, the amount requested for any Subcontractor and material supplier in the requested progress payment, and the amount to be paid to the Contractor from such progress payment, together with similar sworn statements from all such Subcontractors and material suppliers; (ii) duly executed waivers of mechanics' and material suppliers' liens from all Subcontractors and, when appropriate, from material suppliers and lower tier Subcontractors establishing payment or satisfaction of payment of all amounts requested by the Contractor on behalf of such entities or persons in any previous Application for Payment; and (iii) all information and materials required to comply with the requirements of the Contract Documents or reasonably requested by the Construction Manager. A sample Lien Waiver and Release Form is attached hereto as an Exhibit to this Contract. Owner reserves the right to modify the form of this Lien Waiver and Release.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location

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agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials and equipment relating to the Work.

§ 9.4 Certificates for Payment

§ 9.4.1 Where there is only one Contractor, the Construction Manager will, within seven days after the Construction Manager's receipt of the Contractor's Application for Payment, review the Application, certify the amount the Construction Manager determines is due the Contractor, and forward the Contractor's Application and Certificate for Payment to the Architect. Within seven days after the Architect receives the Contractor's Application for Payment from the Construction Manager, the Architect will either (1) issue to the Owner a Certificate for Payment, in the full amount of the Application for Payment, with a copy to the Construction Manager; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Construction Manager and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Construction Manager and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1. The Construction Manager will promptly forward to the Contractor the Architect's notice of withholding certification.

§ 9.4.2 Where there is more than one Contractor performing portions of the Project, the Construction Manager will, within seven days after the Construction Manager receives all of the Contractors' Applications for Payment: (1) review the Applications and certify the amount the Construction Manager determines is due each of the Contractors; (2) prepare a Summary of Contractors' Applications for Payment by combining information from each Contractor's application with information from similar applications for progress payments from the other Contractors; (3) prepare a Project Application and Certificate for Payment; (4) certify the amount the Construction Manager determines is due all Contractors; and (5) forward the Summary of Contractors' Applications for Payment and Project Application and Certificate for Payment to the Architect.

§ 9.4.2.1 Within seven days after the Architect receives the Project Application and Project Certificate for Payment and the Summary of Contractors' Applications for Payment from the Construction Manager, the Architect will either (1) issue to the Owner a Project Certificate for Payment, with a copy to the Construction Manager; or (2) issue to the Owner a Project Certificate for Payment for such amount as the Architect determines is properly due, and notify the Construction Manager and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Project Application for Payment, and notify the Construction Manager and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1. The Construction Manager will promptly forward the Architect's notice of withholding certification to the Contractors.

§ 9.4.3 The Construction Manager's certification of an Application for Payment or, in the case of more than one Contractor, a Project Application and Certificate for Payment, shall be based upon the Construction Manager's evaluation of the Work and the data in the Application or Applications for Payment. The Construction Manager's certification will constitute a representation that, to the best of the Construction Manager's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is, or Contractors are, entitled to payment in the amount certified.

§ 9.4.4 The Architect's issuance of a Certificate for Payment or, in the case of more than one Contractor, Project Application and Certificate for Payment, shall be based upon the Architect's evaluation of the Work, the recommendation of the Construction Manager, and data in the Application for Payment or Project Application for Payment. The Architect's certification will constitute a representation that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is, or Contractors are, entitled to payment in the amount certified.

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§ 9.4.5 The representations made pursuant to Sections 9.4.3 and 9.4.4 are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Construction Manager or Architect.

§ 9.4.6 The issuance of a Certificate for Payment or a Project Certificate for Payment will not be a representation that the Construction Manager or Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Construction Manager or Architect may withhold a Certificate for Payment or Project Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Construction Manager's or Architect's opinion the representations to the Owner required by Section 9.4.3 and 9.4.4 cannot be made. If the Construction Manager or Architect is unable to certify payment in the amount of the Application, the Construction Manager will notify the Contractor and Owner as provided in Section 9.4.1 and 9.4.2. If the Contractor, Construction Manager and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment or a Project Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Construction Manager or Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment or Project Certificate for Payment previously issued, to such extent as may be necessary in the Construction Manager's or Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from the acts and omissions described in Section 3.3.2 because of

.1 defective Work not remedied;
.2 third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
.3 failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
.4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
.5 damage to the Owner or a Separate Contractor or other Contractor;
.6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
.7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.4 If the Architect or Construction Manager withholds certification for payment under Section 9.5.1, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Construction Manager, and both will reflect such payment on the next Certificate for Payment. The Contractor and such Subcontractor shall be responsible for the allocation and disbursement of funds included as part of any such joint payment. In no event shall any joint payment be construed to create any (i) contract between the Owner and a Subcontractor of any tier, (ii) obligations from the Owner to such Subcontractor or (iii) rights in such Subcontractor against the Owner.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment or Project Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Construction Manager and Architect.

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§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Construction Manager will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Owner, Construction Manager and Architect on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner, Construction Manager nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

§ 9.7 Failure of Payment

If the Construction Manager and Architect do not issue a Certificate for Payment or a Project Certificate for Payment, through no fault of the Contractor, within fourteen days after the Construction Manager's receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Construction Manager and Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner, Construction Manager and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so the Owner can occupy or utilize the Work for its intended use provided, however, that as a condition precedent to Substantial Completion, the Owner has received all certificates of occupancy and any other permits, approvals, licenses, and other documents from any government authority having jurisdiction thereof necessary for the beneficial occupancy of the Project.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall notify the Construction Manager, and the Contractor and

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Construction Manager shall jointly prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the list, the Architect, assisted by the Construction Manager, will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect, assisted by the Construction Manager, to determine Substantial Completion.

§ 9.8.4 When the Architect, assisted by the Construction Manager, determines that the Work of all of the Contractors, or designated portion thereof, is substantially complete, the Construction Manager will prepare, and the Construction Manager and Architect shall execute, a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor and Construction Manager shall jointly prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect after consultation with the Construction Manager.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Construction Manager, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon completion of the Work, the Contractor shall forward to the Construction Manager a notice that the Work is ready for final inspection and acceptance, and shall also forward to the Construction Manager a final Contractor's Application for Payment. Upon receipt, the Construction Manager shall perform an inspection to confirm the completion of Work of the Contractor. The Construction Manager shall make recommendations to the Architect when the Work of all of the Contractors is ready for final inspection, and shall then forward the Contractors' notices and Application for Payment or Project Application for Payment, to the Architect, who will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Construction Manager and Architect will promptly issue a final Certificate for Payment or Project Certificate for Payment stating that to the best of their knowledge, information and belief, and on the basis of their on-site visits and inspections, the Work has been completed in accordance with the Contract

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Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Construction Manager's and Architect's final Certificate for Payment or Project Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled. All warranties and guarantees required under or pursuant to the Contract Documents shall be assembled and delivered by the Contractor to the Construction Manager as part of the final Application for Payment. The final Certificate for Payment will not be issued by the Architect until all warranties and guarantees have been received and accepted by the Owner.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect through the Construction Manager (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Construction Manager and Architect so confirm, the Owner shall, upon application by the Contractor and certification by the Construction Manager and Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect through the Construction Manager prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- .1 liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- .2 failure of the Work to comply with the requirements of the Contract Documents;
- .3 terms of special warranties required by the Contract Documents; or
- .4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract. The Contractor shall submit the Contractor's safety program to the Construction Manager for review and coordination with the safety programs of other Contractors. The Construction Manager's responsibilities for review and coordination of safety programs shall not extend to direct control over or charge of the acts or omissions of the Contractors, Subcontractors, agents or employees of the Contractors or Subcontractors, or any other persons performing portions of the Work and not directly employed by the Construction Manager.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

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.1 employees on the Work and other persons who may be affected thereby;
.2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor;
.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction; and
.4 construction or operations by the Owner, Separate Contractors, or other Contractors.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards. The Contractor shall also be responsible at the Contractor's sole cost and expenses, for all measures necessary to protect any property adjacent to the Project and improvements therein. Any damages to such property or improvements shall be promptly repaired by the Contractor.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel. When use or storage of explosives or other hazardous materials or equipment or unusual construction methods are necessary, the Contractor shall give the Owner and the Construction Manager reasonable advance notice.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2, 10.2.1.3 and 10.2.1.4 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2, 10.2.1.3 and 10.2.1.4. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner, Construction Manager or Architect or anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner, Construction Manager and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property
If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.2.9 When all or a portion of the Work is suspended for any reason, the Contractor shall securely fasten down all coverings and protect the work, as necessary, from injury by any cause.

§ 10.2.10 The Contractor shall promptly report in writing to the Construction Manager all accidents arising out of or in connection with the Work that cause death, personal injury or property damage, giving full details and statements of any witnesses. In addition, if death, serious personal injuries or serious damages are caused, the accident shall be reported immediately by telephone or messenger to the Construction Manager.

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§ 10.3 Hazardous Materials

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner, Construction Manager and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor, Construction Manager and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor, the Construction Manager and the Architect will promptly reply to the Owner in writing stating whether or not any of them has reasonable objection to the persons or entities proposed by the Owner. If the Contractor, Construction Manager or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor, the Construction Manager and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Construction Manager, Architect, their consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Construction Manager and Construction Manager's consultants, the Architect and Architect's consultants,

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and any other entities set forth in the Contract Documents, shall be named as additional insureds under the Contractor's commercial general liability, automobile, and umbrella policies or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 11.1.3 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.1.4 Certificates of insurance acceptable to the Owner shall be submitted to the Construction Manager for transmittal to the Owner with a copy to the Architect within fourteen (14) days of the date of the execution of the Contract but no later than ten (10) days prior to commencement of the Work and thereafter upon renewal or replacement of each required policy of insurance.

§ 11.1.5 Notice of Cancellation or Expiration of Contractor's Required Insurance. The insurance policies required by this Section 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner. In addition, within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice directly to the Owner, and separately to the Construction Manager, of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 Failure to Purchase Required Property Insurance. If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform both the Contractor and the Construction Manager, separately and in writing, prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice directly to the Contractor, and separately to the Construction Manager, of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The

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furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

§ 11.3 Waivers of Subrogation

§ 11.3.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Construction Manager and Construction Manager's consultants; (3) the Architect and Architect's consultants; (4) other Contractors and any of their subcontractors, sub-subcontractors, agents, and employees; and (5) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Construction Manager, Construction Manager's consultants, Architect, Architect's consultants, other Contractors, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this Section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

§ 11.3.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor, Architect, and Construction Manager for loss of use of the Owner's property, due to fire or other hazards however caused.

§ 11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Construction Manager, Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Construction Manager, Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

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ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Construction Manager's or Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by either, be uncovered for their examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Construction Manager or Architect has not specifically requested to examine prior to its being covered, the Construction Manager or Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Construction Manager or Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion, and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Construction Manager's and Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof, or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner, Construction Manager or Architect, the Owner may correct it in accordance with Section 2.5.

§ 12.2.2.2 Upon completion of any Work under or pursuant to this Paragraph 12.2, the one (1) year correction period in connection with the Work requiring correction shall be renewed and recommence for the corrective work performed as well as any Work effected by the corrective work. The obligations under Paragraph 12.2 shall cover any repairs and replacement to any part of the Work or other property that is damaged by the defective Work

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner, Separate Contractors, or other Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

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§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender or other entity providing construction financing for the Project or credit enhancement, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Construction Manager, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Construction Manager and Architect timely notice of when and where tests and inspections are to be made so that the Construction Manager and Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Construction Manager, Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Construction Manager and Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Construction Manager and Architect of when and where tests and inspections are to be made so that the Construction Manager and Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Construction Manager's and Architect's services and expenses, shall be at the Contractor's expense.

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§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Construction Manager for transmittal to the Architect.

§ 13.4.5 If the Construction Manager or Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Construction Manager or Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

{Intentionally omitted}

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

.1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;

.2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;

.3 Because the Construction Manager has not certified or the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or

.4 The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon fifteen (15) days' notice to the Owner, Construction Manager and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination. In the event of such a notice of termination, Contractor agrees that Owner can assign this Contract to its Lender, if any. In the event that the Owner does not so assign the Contract, the Contractor can recover as its sole remedy payment for Work properly performed in connection with the terminated portion of the Work prior to the effective date of termination and for items properly and timely fabricated off the Project site, delivered and stored in accordance with the Owner's instructions. The Contractor hereby waives and forfeits all other claims for payment and damages, including, without limitation, anticipated profits. The Owner shall be credited for (i) payments previously made to the Contractor for the termination portion of the Work, (ii) claims that the Owner has against the Contractor for the terminated portion of the Work, (ii) claims that the Owner has against the Contractor under the Contract, and (iii) the value of the materials, supplies, equipment, or other items that are to be disposed of by the Contractor that are part of the Contract Sum.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees, or any other persons performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner, Construction Manager and Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

.1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;

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.2 fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
.3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
.4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:
.1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
.2 Accept assignment of subcontracts pursuant to Section 5.4; and
.3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Construction Manager's and Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall, upon application, be certified by the Initial Decision Maker after consultation with the Construction Manager, and this obligation for payment shall survive termination of the Contract.

§ 14.2.5 In the event that the Owner terminates the Contract for cause, and such cause is determined to be valid, in addition to and without prejudice all other rights, remedies and relief which the Owner may obtain under this Agreement, and pursuant to law, the Owner shall be entitled to payment by Contractor of all reasonable professional fees, including attorney fees, architectural fees, engineering fees and consulting fees (together with reasonable expenses and disbursements incurred in connection therewith), which the Owner may incur in connection with any legal proceedings or actions (including professional fees rendered in anticipation of such proceedings or action). This provision shall create no right to the Contractor or to any other person or entity for payment of such costs or expenses.

§ 14.2.6 If it is determined by a court of competent jurisdiction, the cause for termination under Article 14.2 did not exist, then such termination shall be treated as a termination for convenience under Article 14.4.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and the Contract Time shall be adjusted for increases in the cost and time caused by suspension under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent:
.1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or
.2 that an equitable adjustment is made or denied under another provision of this Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall
.1 cease operations as directed by the Owner in the notice;
.2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and

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.3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 Upon such termination, the Contractor shall recover as its sole remedy payment for Work properly performed in connection with the terminated portion of the Work prior to the effective date of termination and for items properly and timely fabricated off the Project site, delivered and stored in accordance with the Owner's instructions. The Contractor hereby waives and forfeits all other claims for payment and damages, including without limitation, anticipated profits. The Owner shall be credited for (i) payments previously made to the Contractor for the terminated portion of the Work (ii) claims that the Owner has against the Contractor under the Contract and (iii) the value of the materials, supplies, equipment, or other items that are to be disposed of by the Contractor that are part of the Contract Sum.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition. A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Construction Manager and Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later provided, however, that the Contractor shall use its best efforts to furnish the Construction Manager, as expeditiously as possible, with notice of any Claim once such claim is recognized and shall cooperate with the Construction Manager, the Architect and the Owner in an effort to mitigate the alleged or potential damages, delay or other adverse consequences arising out of the condition that is the cause of such a Claim.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost. If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

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§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated and had an adverse effect on the scheduled construction.

§ 15.1.7 Waiver of Claims for Consequential Damages. The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

.1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

.2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties, the Construction Manager, and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial

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decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time.{Intentionally omitted}

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution. The decision to mediate, however, shall be at the Owner's sole discretion. Once the Owner decides not to mediate the dispute and rejects mediation in writing, mediation will no longer be a condition precedent to any action pursuant to Section15.4 below.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.3.5 In the event of mediation, the parties agree that they will attempt to agree to the identity of the mediator. If the parties are unable to agree within fifteen (15) business days from the date of the filing of a Demand for Mediation, the parties shall permit the selection process and the mediation to be administered by the American Arbitration Association.

§ 15.4 Arbitration or Litigation

§ 15.4.1 The Owner may elect to subject Claims, disputes or other matters in question between the parties to this Agreement arising out of this Agreement to resolution by arbitration or litigation. This election can be made at any time by the Owner. The Contractor hereby waives the right to elect the method of dispute resolution and agrees that this waiver is supported by sufficient and appropriate consideration. Unless the parties mutually agree otherwise, in the event of arbitration such proceeding shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. Any arbitration or court proceeding shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. The arbitrator(s) or court shall apply the law of the Commonwealth of Pennsylvania without consideration of choice of law analysis.

{Intentionally omitted}

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§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 IN THE EVENT OF LITIGATION, THE PARTIES MUTUALLY AGREE TO WAIVE THEIR RIGHT TO A JURY.

§ 15.4.5 The prevailing party in any dispute resolution process shall be entitled to recover all costs incurred in any dispute resolution including but not limited to attorney's fees, expert fees, and court and arbitration costs.

§ 15.4.6 Consolidation or Joinder

§ 15.4.6.1 Notwithstanding anything to the contrary contained in this Agreement, Contractor waives all objections to joinder of the Contractor as a party to any mediation, arbitration, or litigation related to this Project in which the Owner is joined or is otherwise positioned as a party and in which the Contractor's conduct or his performance of professional services is in any way relevant to the subject of a dispute. {Intentionally omitted} {Intentionally omitted} .

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SECTION 00 7300 - CONDITIONS OF THE CONTRACT - SPECIAL CONDITIONS

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS

A. The Contract Documents shall include: Refer to Section 1.1.1 of the General Conditions of the Contract for construction.

1.2 SIGNS

A. No signs or advertisement will be allowed to be displayed without the approval of the Owner.

1.3 NON-DISCRIMINATION PROVISION

A. DISCRIMINATION PROHIBITED: According to 62 Pa. C.S.A. 3701, the contractor agrees that:

1. In the hiring of employees for the performance of work under the contract or any sub-contract, no contractor, subcontractor or any person acting on behalf of the contractor or subcontractor shall by reason of gender, race, creed or color discriminate against any citizen of the Commonwealth of Pennsylvania who is qualified and available to perform the work to which the employment relates.

2. No contractor or sub-contractor or any person on their behalf shall in any manner discriminate against or intimidate any employee hired for the performance of work under the contract on account of gender, race, creed or color.

3. The contract may be canceled or terminated by the Intermediate Unit and all money due or to become due under the contract may be forfeited for a violation of the terms or conditions of this portion of the contract.

1.4 HUMAN RELATIONS ACT

A. The provisions of the Pennsylvania Human Relations Act, Act 222 of October 27, 1955 (P.L. 744) (43 P.S. Section 951, et. seq.) of the Commonwealth of Pennsylvania prohibit discrimination because of race, color, religious creed, ancestry, age, sex, national origin, handicap or disability, by employers, employment agencies, labor organizations, contractors and others. The contractor shall agree to comply with the provisions of this Act as amended that is made part of this specification. Your attention is directed to the language of the Commonwealth's non-discrimination clause in 16 PA. Code 49.101.

1.5 EMPLOYMENT VERIFICATION ACT

A. The Pennsylvania Public Works Employment Verification Act (43 P.S. §§ 167.1-167.11) requires Contractors and Subcontractors performing work on "public works projects" to comply with federal employment eligibility requirements, including verification through the U.S. Department of Homeland Security's E-Verify program which compares I-9 employment verification data to data from the Department of Homeland Security and Social Security Administration records, in order to confirm that employees are authorized to work in the United States.

B. All Contractors shall submit a "Public Works Employment Verification Form" to the Owner through the Architect at the same time when performance and payments bonds are submitted. Submission of this form is a precondition of the Contract being awarded and executed. These requirements apply to all employees hired by the Contractor or Subcontractor regardless of whether the employee will be working onsite or offsite.

C. Subcontracts between the Contractor and its Subcontractors or between any Subcontractor and its Subcontractors are required to contain notification of applicability of the Act, the requirement to provide a "Public

Works Employment Verification Form" as stated under item D below, and reference to the Department of General Services website as stated under item F below.

D. All Subcontractors shall submit a "Public Works Employment Verification Form" to the Contractor, who shall submit the form to the Owner through the Construction Manager prior to the Subcontractor beginning either onsite or offsite work. Submission of this form shall be a precondition of the Subcontract remaining in force, and the Contractor shall terminate the Subcontract if the Subcontractor does not comply. These requirements apply to all employees hired by the Subcontractor regardless of whether the employee will be working onsite or offsite. "Subcontractor" includes any entity that performs work on the project other than the prime Contractor and other than an individual. The term does not include an entity that is solely a material supplier for the project.

E. The Contractor or Subcontractor shall be responsible for any penalties imposed for failure to comply with this Act.

F. Contractors and Subcontractors may access the form at www.dgs.state.pa.us. The Chapter 66 Guidelines may be located at http://www.pabulletin.com/secure/data/vol42/42-52/index.html.

1.6 COMPLIANCE WITH STEEL PRODUCTS PROCUREMENT ACT

A. Provision For The Use Of Steel And Steel Products Made In The U.S.: In accordance with Act 3 of the 1978 General Assembly of the Commonwealth of Pennsylvania, if any steel or steel products are to be used or supplied in the performance of the contract, only those produced in the United States as defined therein shall be used or supplied in the performance of the contract or any subcontracts thereunder.

B. In accordance with Act 161 of 1982, cast iron products shall also be included and produced in the United States. Act 144 of 1984 further defines "steel products" to include machinery and equipment. The act also provides clarifications and penalties.

1.7 NO CASH ALLOWANCES:

A. Cash allowances are prohibited.

1.8 NATIONAL ELECTRIC CODE COMPLIANCE

A. All equipment using electrical energy or connected to the electrical system must be wired in accordance with the established standards of the National Electrical Code as recommended by the National Fire Protection Association.

B. A Certificate of Approval of all such equipment shall be submitted, in duplicate, to the Project Engineer. Electrical components of the equipment shall be listed by the Underwriters' Laboratories for the appropriate service.

1.9 PENNSYLVANIA PREVAILING WAGE ACT

A. This regulation and the general Pennsylvania prevailing minimum wage rates, (Act 442 of 1961, P.L. 987, amended), as determined by the Secretary of Labor and Industry, which shall be paid for each craft or classification of all workers needed to perform the contract during the anticipated term therefore in the locality in which public work is performed, are made part of this specification.

B. The Contractor shall be required in accordance with the laws and under the terms of the Contract to pay the prevailing minimum wage rate for the various classes of labor in accordance with the wage determination issued by the Department of Labor and Industry. The general prevailing minimum wage rate for the described classes of workers shall be in accordance with the law.

C. The wage determination decision shall be used during the anticipated term of the Contract unless otherwise modified and shall be made a part of every contract for the performance of the described work as provided in the

Pennsylvania Prevailing Wage Act and Regulations of the Secretary of Labor and Industry and the wage rates contained in this decision shall be the minimum wage rates to be paid under any such contract by Contractors and Subcontractors on the public work project. Section 8 of the Act allows an appeal to the Secretary of Labor and Industry to review this Pre-determination on verified petition.

D. Any class of laborers and mechanics not listed in the Secretary's decision which will be employed on the Contract shall be classified or reclassified by the Contractor or Subcontractor conformably to the Secretary's decision and report of the administrative action taken in such cases by the authorized officer of the contracting agency shall be transmitted to the Secretary of Labor and Industry. In the event the interested parties cannot agree on the proper classification or reclassification for a particular class of workers to be used, the question accompanied by the recommendation of the contracting office shall be referred to the Secretary of Labor and Industry for final determination. Where classifications of workers which were not included in the original decision are desired, a supplementary wage determination shall be requested by the Intermediate Unit.

E. The School District is advised that where classification, reclassification or additional classification of workers are made in accordance with the Prevailing Wage Act and the Regulations, the Contractor shall have no claim against the contracting agency for additional compensation for such classification, reclassification or additional classification.

F. The Contract shall provide that the Contractor and each Subcontractor shall post for the entire period of construction, the wage determination decision of the Secretary, including the effective date of any changes thereof, in a prominent and easily accessible place or places at the site of the work and at such place or places used by them to pay workers their wages.

G. The Contract shall also provide that each Contractor and each Subcontractor shall file a statement each week and a final statement at the conclusion of the work on the Contract with the contracting agency, under oath, and in form satisfactory to the Secretary, certifying that all workers have been paid wages in strict conformity with the provisions of the Contract as prescribed by Section 3 of the Regulations, or if any wages remain unpaid to set forth the amount of wages due and owing to each worker respectively.

H. The Provisions of the Act and these Regulations shall be incorporated by reference in the Contract.

I. Refer to Section 00 73 43.1 "Prevailing Wage Determination Schedule," dated October 2, 2026, furnished by the Commonwealth of Pennsylvania Department of Labor and Industry specifically for this project.

1.10 RIGHT TO KNOW LAW.

A. If Owner receives a request for public records under Pennsylvania’s Right to Know Law that pertains to documents within Contractor’s possession, Contractor shall cooperate fully in providing such records to Owner without any charges to Owner beyond charges that Owner can pass along to the requester under the Right to Know Law. Contractor also agrees to not issue any request to Owner under the Right to Know Law pertaining in any manner to the Project, either directly or indirectly through any individual, and agrees further that in the event such a request is nonetheless made to Owner in violation of this commitment, to reimburse Owner all costs incurred responding to such request, including the cost of any attorney fees and the cost of any School District personnel time at the burdened labor rate. The duties in this Article 17 apply also to Contractor’s surety, extend beyond Final Completion of this Project and continue after termination of Contractor’s agreement with Owner.

1.11 CHILD PROTECTIVE SERVICES BACKGROUND CHECKS.

A. Prior to commencing the work under the Contract, Contractor shall submit for any employee or independent contractor who would be working on the job site, pursuant to any work contemplated in the Contract, an official clearance statement obtained from the Pennsylvania Department of Public Welfare, pursuant to Act 151 of December 16, 1959 (P.L. 1292), Subchapter C.2. of the Child Protective Services Act. Contractor shall not allow

any prospective employee or independent contractor on the job site prior to providing Owner with the above-referenced clearance statement for prospective employees or independent contractors.

B. Section 1-111. Pennsylvania Public School Code (Act 34). Pursuant to §1-111 of the Pennsylvania Public School Code of 1949, prior to commencing work under the Contract, Contractor shall submit for any employee of the contractor or a subcontractor who would be working on the job site, pursuant to work contemplated in the Contract, a report of criminal history record information from the Pennsylvania State Police or a statement from the Pennsylvania State Police that the State Police central repository contains no such information relating to that person. Contractor shall produce the original document for each prospective employee or independent contractor of such Contractor prior to employment. Contractor shall also submit for each of its employees and employees of its subcontractors a report of federal criminal history record information pursuant to the Federal Bureau of Investigation appropriation of Title II of Public Law 92-544. Contractor shall not allow any prospective employee or sub-contractor on the job site prior to providing Owner with the above-referenced criminal history record information for said prospective employee or employee of a sub-contractor. Nothing herein contained shall limit Owner's right to object to any person or entity proposed by the Contractor pursuant to Paragraph 3.4.2 and 5.2 of the General Conditions of Contract.

C. Additional Requirements.

1. Act 34 clearances are required of all workers who will be on the Job Site.
2. Act 151, PA Child Abuse History Clearance, is required of all workers who will be on the Job Site.
3. FBI Fingerprints are required of all workers who will be on the job site.
4. Contractor and its subcontractors shall comply with employment history review requirements of School Code Section 111.1 for all employees working on the job site.
5. Contractor and its subcontractors shall provide clearances to the School District within one (1) year of submission prior to contractors arriving on site.
6. Clearances must be sent to Sandra Szabo of Boyle Construction at sszabo@boyleconstruction.com, at least 48 hours prior to working on site.

1.12 DRUG CONVICTIONS.

A. Employees or independent contractors who are convicted of delivery of a controlled substance or convicted of possession of a controlled substance with intent to deliver as prohibited by the Act of April 14, 1972 (P.L. 233, No. 64), known as the Controlled Substance, Drug, Device and Cosmetic Act, shall not be permitted on district property.

1.13 ANTI-POLLUTION LEGISLATION.

A. Act 247 of 1972, 53 P.S. §1612, requires that bidders on construction contracts for the Commonwealth of Pennsylvania and its political subdivisions be advised of those provisions of federal and state statutes, rules and regulations, dealing with the prevention of environmental pollution and the preservation of public natural resources that affect a project on which bids are received. Pursuant to the Act, the Pennsylvania Department of Environmental Resources has prepared a notice of said provisions. Contractor is hereby notified of and agrees to comply with the terms of said notice, and all statutes, rules and regulations enumerated therein.

1.14 INDUSTRY STANDARDS.

A. Except for where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if found or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference. Contractors are noticed to comply with standards in effect as of the date of the Contract Documents. Where compliance with two or more standards as specified in the standards establish different or conflicting requirements for minimum quantities or quality levels, refer inquiries to the Architect for decision before preceding.

1.15 FEDERAL LAW.

A. The joint and several phases of construction hereby contemplated are to be governed, at all times, by all applicable provisions of federal law, including, but not limited to, the following:

4. Williams-Steiger Occupational Safety and Health Act of 1970, P.L. 91-596 and its implementing regulations, including, but not limited to Title 29 C.F.R. Part 1926, Safety and Health Regulations for Construction.

B. Nothing contained in these contract documents for construction shall be construed by the Contractor as relieving him in any way of his responsibility for strict compliance with the rules and regulations contained in the above-mentioned Occupational Safety and Health Act and affirmative action requirements.

C. All Applicable Laws, Statutes, Regulations and Standards. Contractor shall comply with all applicable federal, state, local and industry statutes, regulations, ordinances, codes and standards. The failure to specifically reference or include said matters in the Contract Documents does not excuse Contractor from compliance with same.

1.16 ACCESS TO ACCOUNTING RECORDS

A. The Contractor shall check all materials, equipment and labor entering into the Work and shall keep such full and detailed accounts as may be necessary for proper financial management under this Agreement and the system shall be satisfactory to the Owner. The Owner or its representative shall be afforded access to all the Contractor's records, books, correspondence, instructions, drawings, receipts vouchers, memoranda, and similar data relating to this Contract, and the Contractor shall preserve all such records for period of three years, or for such longer period as may be required by law, after the final payment.

1.17 ASSIGNMENT OF REFUND RIGHTS

A. The Contractor hereby assigns and transfers to the Owner all its rights to sales and use tax which may be refunded as a result of a claim for refund for materials purchased in connection with this contract. The Contractor further agrees that it will not file a claim for refund for any sales or use tax which is the subject of this assignment.

1.18 CONTRACTS WITH SUBCONTRACTORS

A. The Contractor agrees to include "Access to Accounting Records" and "Assignment of Refund Rights" paragraphs, in full, in any contracts with subcontractors.

PART 2 - A. PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

PART 4 - MISCELLANEOUS (Not Applicable)

END OF CONDITIONS OF THE CONTRACT - SPECIAL CONDITIONS

SECTION 00 73 43 - PREVAILING WAGE RATE REQUIREMENTS

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Prevailing Wage Act.
2. Pennsylvania Prevailing Wage Determination Schedule follows as Section 00 73 43.1.
3. Pennsylvania Department of Labor and Industry "Weekly Payroll Certification for Public Works Projects" Form LLC-25 follows as Section 00 73 43.2.

1.3 Prevailing Wage Rates

A. The provisions of the Pennsylvania Prevailing Wage Act, Act. No. 442, approved August 15, 1961 (P.L. 987) as amended are hereby incorporated herein and the Contractor and all Subcontractors shall comply with the requirements of the applicable portions thereof and the Regulations issued in connection therewith.

B. Pursuant to the requirements of the above Act, the Prevailing Minimum Wage Predetermination is attached hereto and hereby made part of the Contract Documents.

C. The general prevailing minimum wage rates including contributions for employee benefits as shall have been determined by the Secretary of Labor and Industry (hereinafter "Secretary"), which must be paid to the workmen, employed in the performance of the Contract.

D. All Prime Contractors shall submit (3) copies of weekly certification forms with their payment requisitions. The form to be used is the latest edition of the Department of Labor and Industry form "Contractor's or Subcontractor's Weekly Payroll Certification for Public Works Projects" (forms LIPW-123 and LIPW-124).

E. There shall be paid each laborer or mechanic of the Contractor or Subcontractor engaged in the Work on this Project, in the trade or occupation listed on the attached Prevailing Minimum Wage Predetermination, not less than the hourly wage rate set opposite the same, regardless of any contractual relationship which may be alleged to exist between the Contractor, or any Subcontractor, and such laborers and mechanics.

F. These Contract provisions shall apply to all work performed on the Contract by the Contractor and to all work performed on the Contract by all subcontractors.

G. The Contractor shall insert in each of his subcontracts all of the stipulations contained in these required provisions.

H. No workmen may be employed on the Work except in accordance with the classifications set forth in the decision of the Secretary. In the event that additional or different classifications are necessary, the procedure set forth in the Regulations shall be followed.

I. All workmen employed or working on the Work shall be paid unconditionally, regardless of whether any contractual relationship exists or the contractual relationship which may be alleged to exist between any contractor, subcontractor, and workmen, not less than once a week without deductions or rebate, on any account, either directly or indirectly, except authorized deductions, the full amount due at the time of payment, computed at the rates applicable to the time worked in

the appropriate classification. Nothing in this Contract, the Act or the Regulations shall prohibit the payment of more than the general prevailing minimum wage rates as determined by the Secretary to the workmen on the Work.

J. Each Prime Contractor or Subcontractor shall post the general prevailing minimum wage rates for each craft and classification involved, as determined by the Secretary of the Department of Labor and Industry, including the effective date of any changes thereof, in prominent and easily accessible places at the site of the work, or at such place or places as are used by them to pay the workmen their wages. The posted notice of wage rates must contain the following information:

1. Name of project.
2. Name of public body of which it is constructed.
3. The crafts and classifications of workmen listed in the Secretary's general prevailing minimum wage rate determination for the particular project.
4. The general prevailing minimum wage rates determined for each craft and classification and the effective date of any changes.
5. A statement advising workmen that if they have been paid less than the general prevailing minimum wage rate for their job classification or that the Contractor and/or subcontractor are not complying with the Act or the Regulations in any manner whatsoever, they may file a protest with the Secretary within three (3) months of the date of the occurrence, objecting to the payment to the Contractor to the extent of the amount or amounts due or to become due to them as wages for work performed on the Project. Any workmen paid less than the rate specified in the Contract shall have a civil right of action for the difference between the wage paid and wages stipulated in the Contract, which right of action must be exercised within six (6) months from the occurrence of the event creating such right.

K. The Contractor and all subcontractors shall keep an accurate record **showing the name, craft and/or classification, number of hours worked per day, and the actual hourly rate of wage paid (including employee benefits) to each workman employed by him in connection with the Work and such record must include any deductions from each workman.** The record shall be preserved for two (2) years from the date of payment and shall open at all reasonable hours to the inspection of the Owner and to the Secretary or his duly authorized representative.

1. Apprentices shall be limited to such numbers as shall be in accordance with a bona fide apprenticeship program registered with and approved by the Pennsylvania Apprenticeship and Training Council and only apprentices whose training and employment are in full compliance with the provisions of the Apprenticeship and Training Act approved July 14, 1961 (Act No. 304) and the Rules and Regulation issued pursuant thereto shall be employed on the Work. Any workmen using the tools of a craft that does not qualify as an apprentice within the provisions of this submission shall be paid the rate predetermined for journeyman in that particular craft and/or classification.

L. Wages shall be paid without any deductions except authorized deductions. Employers not party to a contract requiring contributions for employee benefits which the Secretary has determined to be included in the general prevailing minimum wage rate shall pay the monetary equivalent thereof directly to the workman.

M. Payment of compensation to workmen for work performed on public work on a lump sum basis, or apiece work system, or a price certain for the completion of a certain amount of work, or the production of a certain result shall be deemed a violation of the Act and the Regulations, regardless of the average hourly earnings resulting therefrom.

N. Each Contractor and each subcontractor shall file a statement each week and a final statement at the conclusion of the Work on the Contract with Owner, under oath, and in form satisfactory to the Secretary, certifying that all workmen have been paid wages in strict conformity with the provisions of the Contract as prescribed by the Regulations, or if any wages remain unpaid, to the amount of wages due and owing to each workman respectively.

O. The provision of the Act and the Regulations are incorporated by reference in the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

A. Prevailing wage certification forms are to be produced weekly and are to be submitted monthly. Prevailing wage certificates are to be sent to Architect and CM with a pencil copy of the Application for Payment. No Applications for Payment will be processed without the proper prevailing wage certificates. Contractor may be requested to submit the prevailing wage certification forms in any of the following manners:

1. If hard paper copies are submitted, Contractor shall submit two (2) copies of each prevailing wage certification form.
2. If digital copies are submitted, Contractor shall submit to Architect and CM in PDF form.
3. Redacted certified payroll:

a. Prevailing wage certification forms submitted to the Owner may not be redacted by law; however, if there is a Project Right-to-Know request, the Contractor will be required to submit redacted prevailing wage certification forms **in addition** to the required unredacted forms. The following information may be redacted:

1) Employee Name
2) Employee Address
3) Employee Social Security Number

B. Contractor shall use the Commonwealth of Pennsylvania Department of Labor and Industry Form LLC-25 (form can be accessed at: http://www.dli.pa.gov/Individuals/Labor-Management-Relations/Documents/llc-25.pdf), as revised from time to time, and ensure proper classification of workmen are assigned to each person. Certificates must be filled out in their entirety. Form is included as Specification Section 007346.16. Certified Payroll submitted on U.S. Wage and Hour Division forms are NOT accepted and will be returned to the Contractor.

C. Regardless of the submission type, the first and the final certification forms must be notarized, signed, and dated.

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project Name:	CRSD - Chancellor Center Renovations
General Description:	Renovations to the Chancellor Center
Project Locality	Newtown Borough
Awarding Agency:	Council Rock School District
Contract Award Date:	12/18/2026
Serial Number:	26-08833
Project Classification:	Building
Determination Date:	10/2/2026
Assigned Field Office:	Philadelphia
Field Office Phone Number:	(215)560-1858
Toll Free Phone Number:	
Project County:	Bucks County

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 26-08833 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Asbestos & Insulation Workers	5/1/2026		$64.51	$50.26	$114.77
Boilermaker (Commercial, Institutional, and Minor Repair Work)	3/1/2026		$41.34	$19.23	$60.57
Boilermakers	1/1/2026		$58.00	$36.57	$94.57
Bricklayer	5/1/2026		$51.15	$34.92	$86.07
Carpenter - Chief of Party (Surveying & Layout)	5/1/2026		$55.83	$30.39	$86.22
Carpenter - Chief of Party (Surveying & Layout)	5/1/2027		$58.03	$30.74	$88.77
Carpenter - Chief of Party (Surveying & Layout)	5/1/2028		$60.29	$31.09	$91.38
Carpenter - Chief of Party (Surveying & Layout)	5/1/2029		$62.63	$31.44	$94.07
Carpenter - Instrument Person (Surveying & Layout)	5/1/2026		$48.55	$30.39	$78.94
Carpenter - Instrument Person (Surveying & Layout)	5/1/2027		$50.46	$30.74	$81.20
Carpenter - Instrument Person (Surveying & Layout)	5/1/2028		$52.43	$31.09	$83.52
Carpenter - Instrument Person (Surveying & Layout)	5/1/2029		$54.46	$31.44	$85.90
Carpenter - Instrument Person (Surveying & Layout)	5/1/2030		$56.55	$31.79	$88.34
Carpenter - Rodman (Surveying & Layout)	5/1/2026		$24.28	$21.99	$46.27
Carpenter - Rodman (Surveying & Layout)	5/1/2027		$25.23	$22.34	$47.57
Carpenter - Rodman (Surveying & Layout)	5/1/2028		$26.22	$22.69	$48.91
Carpenter - Rodman (Surveying & Layout)	5/1/2029		$27.23	$23.04	$50.27
Carpenter - Rodman (Surveying & Layout)	5/1/2030		$28.28	$23.39	$51.67
Carpenters	5/1/2026		$48.55	$30.39	$78.94
Carpenters	5/1/2027		$50.46	$30.74	$81.20
Carpenters	5/1/2028		$52.43	$31.09	$83.52
Carpenters	5/1/2029		$54.46	$31.44	$85.90
Carpenters	5/1/2030		$56.55	$31.79	$88.34
Cement Masons	5/1/2024		$46.70	$32.46	$79.16
Cement Masons	5/1/2025		$48.70	$32.46	$81.16
Dockbuilder, Pile Drivers	5/1/2026		$56.98	$37.99	$94.97
Dockbuilder/Pile Driver Diver	5/1/2026		$66.54	$41.74	$108.28
Dockbuilder/pile driver tender	5/1/2026		$56.98	$37.99	$94.97
Drywall Finisher	5/1/2025		$40.14	$32.35	$72.49
Drywall Finisher	5/1/2026		$41.10	$32.99	$74.09
Electricians	7/7/2025		$61.87	$41.05	$102.92
Electricians	1/5/2026		$63.82	$42.95	$106.77
Electricians	1/4/2027		$66.08	$44.44	$110.52
Electricians	1/3/2028		$68.19	$45.83	$114.02
Electricians	1/1/2029		$70.30	$47.22	$117.52
Electricians	1/7/2030		$72.26	$48.51	$120.77
Electricians	1/6/2031		$74.22	$49.80	$124.02
Elevator Constructor	1/1/2025		$71.85	$45.77	$117.62
Elevator Constructor	1/1/2026		$74.86	$46.86	$121.72
Floor Coverer	5/1/2025		$51.67	$31.69	$83.36
Floor Coverer	5/1/2026		$52.84	$32.86	$85.70
Glazier	5/1/2025		$49.96	$38.34	$88.30
Glazier	5/1/2026		$51.30	$39.37	$90.67
Interior Finish	5/1/2023		$34.60	$25.80	$60.40

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 26-08833 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Iron Workers (Bridge, Structural, Ornamental, Precast)	7/1/2024		$53.20	$45.01	$98.21
Iron Workers (Riggers)	7/1/2025		$44.77	$36.27	$81.04
Iron Workers (Riggers)	7/1/2026		$48.84	$36.52	$85.36
Iron Workers (Rodman/Reinforcing)	7/1/2025		$47.80	$36.65	$84.45
Iron Workers (Rodman/Reinforcing)	7/1/2026		$52.39	$36.90	$89.29
Laborers (Class 01 - See notes)	5/1/2025		$37.25	$26.10	$63.35
Laborers (Class 02 - See notes)	5/1/2025		$41.00	$27.70	$68.70
Laborers (Class 03 - See notes)	5/1/2025		$37.67	$26.28	$63.95
Laborers (Class 04 - See notes)	5/1/2025		$37.67	$26.28	$63.95
Laborers (Class 05 - See notes)	5/1/2025		$37.25	$26.10	$63.35
Landscape Laborer	5/1/2024		$30.70	$24.23	$54.93
Landscape Laborer	5/1/2025		$32.15	$24.30	$56.45
Marble Finisher	5/1/2025		$41.17	$30.75	$71.92
Marble Finisher	5/1/2026		$42.07	$31.85	$73.92
Marble Mason	5/1/2023		$47.20	$31.95	$79.15
Marble Setter	5/1/2026		$51.50	$33.80	$85.30
Mason Tender, Cement	5/1/2023		$35.02	$25.98	$61.00
Millwright	5/1/2025		$57.39	$35.81	$93.20
Millwright	5/1/2026		$60.20	$35.81	$96.01
Operators (Building, Class 01 - See Notes)	5/1/2025		$54.52	$34.49	$89.01
Operators (Building, Class 01 - See Notes)	5/1/2026		$55.67	$35.34	$91.01
Operators (Building, Class 01A - See Notes)	5/1/2025		$57.52	$35.38	$92.90
Operators (Building, Class 01A - See Notes)	5/1/2026		$58.68	$36.22	$94.90
Operators (Building, Class 02 - See Notes)	5/1/2025		$54.27	$34.42	$88.69
Operators (Building, Class 02 - See Notes)	5/1/2026		$55.43	$35.26	$90.69
Operators (Building, Class 02A - See Notes)	5/1/2025		$57.29	$35.29	$92.58
Operators (Building, Class 02A - See Notes)	5/1/2026		$58.44	$36.14	$94.58
Operators (Building, Class 03 - See Notes)	5/1/2025		$50.18	$33.22	$83.40
Operators (Building, Class 03 - See Notes)	5/1/2026		$51.34	$34.06	$85.40
Operators (Building, Class 04 - See Notes)	5/1/2025		$49.88	$33.13	$83.01
Operators (Building, Class 04 - See Notes)	5/1/2026		$51.04	$33.97	$85.01
Operators (Building, Class 05 - See Notes)	5/1/2025		$48.16	$32.62	$80.78
Operators (Building, Class 05 - See Notes)	5/1/2026		$49.32	$33.46	$82.78
Operators (Building, Class 06 - See Notes)	5/1/2025		$47.17	$32.33	$79.50
Operators (Building, Class 06 - See Notes)	5/1/2026		$48.34	$33.16	$81.50
Operators (Building, Class 07A- See Notes)	5/1/2025		$66.26	$39.55	$105.81
Operators (Building, Class 07A- See Notes)	5/1/2026		$67.73	$40.48	$108.21
Operators (Building, Class 07B- See Notes)	5/1/2025		$65.97	$39.46	$105.43
Operators (Building, Class 07B- See Notes)	5/1/2026		$67.44	$40.39	$107.83
Painters Class 1 (see notes)	5/1/2025		$44.38	$34.55	$78.93
Painters Class 1 (see notes)	5/1/2026		$45.71	$35.22	$80.93
Painters - Line Stripping	12/1/2025		$45.12	$29.41	$74.53
Painters Class 4 (see notes)	5/1/2025		$46.47	$34.55	$81.02
Painters Class 4 (see notes)	5/1/2026		$48.45	$35.22	$83.67

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 26-08833 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Plasterers	5/1/2024		$39.88	$33.08	$72.96
plumber	5/1/2025		$70.53	$39.46	$109.99
plumber	5/1/2026		$73.73	$40.36	$114.09
Pointers, Caulkers, Cleaners	5/1/2025		$51.35	$31.80	$83.15
Pointers, Caulkers, Cleaners	5/1/2026		$53.35	$32.30	$85.65
Roofers (Composition)	5/1/2025		$46.03	$34.77	$80.80
Roofers (Composition)	5/1/2026		$47.53	$35.22	$82.75
Roofers (Shingle)	5/1/2024		$34.35	$22.20	$56.55
Roofers (Slate & Tile)	5/1/2024		$37.35	$22.20	$59.55
Sheet Metal Workers	5/1/2025		$62.62	$52.17	$114.79
Sheet Metal Workers	5/1/2026		$65.06	$54.48	$119.54
Sign Makers and Hangars	7/15/2025		$33.48	$26.41	$59.89
Sign Makers and Hangars	7/15/2026		$36.38	$25.01	$61.39
Sprinklerfitters	1/1/2023		$62.23	$31.99	$94.22
Sprinklerfitters	5/1/2025		$70.37	$34.85	$105.22
Steamfitters	5/1/2024		$70.32	$43.09	$113.41
Steamfitters	5/1/2025		$72.52	$44.89	$117.41
Stone Masons	5/1/2025		$50.00	$32.80	$82.80
Stone Masons	5/1/2026		$51.50	$33.80	$85.30
Terrazzo Finisher	5/1/2025		$45.61	$29.41	$75.02
Terrazzo Finisher	5/1/2026		$47.78	$29.61	$77.39
Terrazzo Grinder	5/1/2025		$45.88	$29.41	$75.29
Terrazzo Grinder	5/1/2026		$47.78	$29.61	$77.39
Terrazzo Mechanics	5/1/2025		$52.21	$31.26	$83.47
Terrazzo Mechanics	5/1/2026		$53.36	$32.61	$85.97
Tile Finisher	5/1/2025		$41.17	$30.75	$71.92
Tile Finisher	5/1/2026		$42.07	$31.85	$73.92
Tile Setter	5/1/2025		$52.21	$31.26	$83.47
Tile Setter	5/1/2026		$53.36	$32.61	$85.97
Truckdriver class 1(see notes)	5/1/2026		$38.57	$23.87	$62.44
Truckdriver class 2 (see notes)	5/1/2026		$38.67	$23.87	$62.54
Truckdriver class 3 (see notes)	5/1/2026		$38.92	$23.87	$62.79
Window Film / Tint Installer	6/1/2025		$27.42	$15.13	$42.55
Window Film / Tint Installer	6/1/2026		$28.35	$15.60	$43.95

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 26-08833 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Bricklayer	5/1/2025		$50.00	$32.57	$82.57
Bricklayer	5/1/2026		$51.15	$34.92	$86.07
Carpenter - Chief of Party (Surveying & Layout)	5/1/2025		$65.96	$30.09	$96.05
Carpenter - Chief of Party (Surveying & Layout)	5/1/2026		$67.52	$30.44	$97.96
Carpenter - Instrument Person (Surveying & Layout)	5/1/2025		$58.39	$29.06	$87.45
Carpenter - Instrument Person (Surveying & Layout)	5/1/2026		$60.09	$29.06	$89.15
Carpenter - Rodman (Surveying & Layout)	5/1/2025		$45.88	$23.19	$69.07
Carpenter - Rodman (Surveying & Layout)	5/1/2026		$46.97	$23.54	$70.51
Carpenter	5/1/2025		$57.36	$30.09	$87.45
Carpenter	5/1/2026		$58.71	$30.44	$89.15
Cement Masons	5/1/2023		$43.20	$32.91	$76.11
Cement Masons	5/1/2025		$46.55	$32.66	$79.21
Dockbuilder, Pile Drivers	5/1/2026		$56.98	$37.99	$94.97
Dockbuilder/Pile Driver Diver	5/1/2026		$61.88	$45.47	$107.35
Dockbuilder/pile driver tender	5/1/2026		$56.98	$37.99	$94.97
Electric Lineman	6/3/2024		$62.07	$33.96	$96.03
Electric Lineman	6/2/2025		$65.10	$34.45	$99.55
Iron Workers (Bridge, Structural, Ornamental, Precast)	7/1/2024		$53.20	$45.01	$98.21
Iron Workers (Riggers)	7/1/2023		$42.53	$34.14	$76.67
Iron Workers (Rodman/Reinforcing)	7/1/2023		$45.70	$34.77	$80.47
Laborers (Class 01 - See notes)	5/1/2025		$40.20	$27.80	$68.00
Laborers (Class 01 - See notes)	5/1/2026		$41.65	$27.90	$69.55
Laborers (Class 02 - See notes)	5/1/2025		$40.40	$27.80	$68.20
Laborers (Class 02 - See notes)	5/1/2026		$41.85	$27.90	$69.75
Laborers (Class 03 - See notes)	5/1/2025		$40.40	$27.80	$68.20
Laborers (Class 03 - See notes)	5/1/2026		$41.85	$27.90	$69.75
Laborers (Class 04 - See notes)	5/1/2025		$35.00	$27.80	$62.80
Laborers (Class 04 - See notes)	5/1/2026		$36.45	$27.90	$64.35
Laborers (Class 05 - See notes)	5/1/2025		$41.05	$27.80	$68.85
Laborers (Class 05 - See notes)	5/1/2026		$42.50	$27.90	$70.40
Laborers (Class 06 - See notes)	5/1/2025		$41.10	$27.80	$68.90
Laborers (Class 06 - See notes)	5/1/2026		$42.55	$27.90	$70.45
Laborers (Class 07 - See notes)	5/1/2025		$40.95	$27.80	$68.75
Laborers (Class 07 - See notes)	5/1/2026		$42.40	$27.90	$70.30
Laborers (Class 08 - See notes)	5/1/2025		$40.70	$27.80	$68.50
Laborers (Class 08 - See notes)	5/1/2026		$42.15	$27.90	$70.05
Laborers (Class 09 - See notes)	5/1/2025		$40.55	$27.80	$68.35
Laborers (Class 09 - See notes)	5/1/2026		$42.00	$27.90	$69.90
Laborers (Class 10- See notes)	5/1/2025		$40.70	$27.80	$68.50
Laborers (Class 10- See notes)	5/1/2026		$42.15	$27.90	$70.05
Laborers (Class 11 -See Notes)	5/1/2025		$40.60	$27.80	$68.40
Laborers (Class 11 -See Notes)	5/1/2026		$42.05	$27.90	$69.95
Laborers (Class 12 -See Notes)	5/1/2025		$42.30	$27.80	$70.10
Laborers (Class 12 -See Notes)	5/1/2026		$42.85	$27.90	$70.75

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 26-08833 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Laborers (Class 13 -See Notes)	5/1/2025		$44.33	$27.80	$72.13
Laborers (Class 13 -See Notes)	5/1/2026		$45.78	$27.90	$73.68
Laborers (Class 14 -See Notes)	5/1/2025		$40.90	$27.80	$68.70
Laborers (Class 14 -See Notes)	5/1/2026		$41.90	$27.90	$69.80
Laborers Utility (PGW ONLY) (Flagperson)	5/1/2025		$34.07	$19.73	$53.80
Laborers Utility (PGW ONLY) (Flagperson)	5/1/2026		$35.52	$19.83	$55.35
Laborers Utility (PGW ONLY)	5/1/2025		$41.10	$19.73	$60.83
Laborers Utility (PGW ONLY)	5/1/2026		$42.55	$19.83	$62.38
Landscape Laborer	5/1/2024		$30.28	$24.05	$54.33
Landscape Laborer	5/1/2025		$31.73	$24.15	$55.88
Millwright	5/1/2025		$57.39	$35.81	$93.20
Millwright	5/1/2026		$60.20	$35.81	$96.01
Operators Class 01 - See Notes (Building, Heavy, Highway)	5/1/2025		$54.52	$34.49	$89.01
Operators Class 01 - See Notes (Building, Heavy, Highway)	5/1/2026		$55.67	$35.34	$91.01
Operators Class 01a - See Notes (Building, Heavy, Highway)	5/1/2025		$57.52	$35.38	$92.90
Operators Class 01a - See Notes (Building, Heavy, Highway)	5/1/2026		$58.68	$36.22	$94.90
Operators Class 02 - See Notes (Building, Heavy, Highway)	5/1/2025		$54.27	$34.42	$88.69
Operators Class 02 - See Notes (Building, Heavy, Highway)	5/1/2026		$55.43	$35.26	$90.69
Operators Class 02a - See Notes (Building, Heavy, Highway)	5/1/2025		$57.29	$35.29	$92.58
Operators Class 02a - See Notes (Building, Heavy, Highway)	5/1/2026		$58.44	$36.14	$94.58
Operators Class 03 - See Notes (Building, Heavy, Highway)	5/1/2025		$50.18	$33.22	$83.40
Operators Class 03 - See Notes (Building, Heavy, Highway)	5/1/2026		$51.34	$34.06	$85.40
Operators Class 04 - See Notes (Building, Heavy, Highway)	5/1/2025		$49.88	$33.13	$83.01
Operators Class 04 - See Notes (Building, Heavy, Highway)	5/1/2026		$51.04	$33.97	$85.01
Operators Class 05 - See Notes (Building, Heavy, Highway)	5/1/2025		$48.16	$32.62	$80.78
Operators Class 05 - See Notes (Building, Heavy, Highway)	5/1/2026		$49.32	$33.46	$82.78
Operators Class 06 - See Notes (Building, Heavy, Highway)	5/1/2025		$47.17	$32.33	$79.50
Operators Class 06 - See Notes (Building, Heavy, Highway)	5/1/2026		$48.34	$33.16	$81.50
Operators Class 07 (A) - See Notes (Building, Heavy, Highway)	5/1/2025		$66.26	$39.55	$105.81
Operators Class 07 (A) - See Notes (Building, Heavy, Highway)	5/1/2026		$67.73	$40.48	$108.21
Operators Class 07 (B) - See Notes (Building, Heavy, Highway)	5/1/2025		$65.97	$39.46	$105.43
Operators Class 07 (B) - See Notes (Building, Heavy,	5/1/2026		$67.44	$40.39	$107.83

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES

Project: 26-08833 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Highway)					
Painters - Line Stripping	12/1/2024		$44.12	$27.91	$72.03
Painters - Line Stripping	12/1/2025		$45.12	$29.41	$74.53
Painters Class 2 (see notes)	2/1/2025		$50.85	$33.91	$84.76
Painters Class 2 (see notes)	2/1/2026		$51.61	$35.00	$86.61
Painters Class 3 (see notes)	2/1/2025		$61.81	$33.95	$95.76
Painters Class 3 (see notes)	2/1/2026		$62.57	$35.04	$97.61
Pointers, Caulkers, Cleaners	5/1/2025		$51.35	$31.80	$83.15
Steamfitters (Heavy and Highway - Gas Distribution)	5/1/2024		$66.80	$42.93	$109.73
Steamfitters (Heavy and Highway - Gas Distribution)	5/1/2025		$68.89	$44.73	$113.62
Truckdriver class 1(see notes)	5/1/2024		$36.64	$22.54	$59.18
Truckdriver class 1(see notes)	5/1/2026		$38.42	$23.87	$62.29
Truckdriver class 2 (see notes)	5/1/2024		$36.74	$22.54	$59.28
Truckdriver class 2 (see notes)	5/1/2026		$38.52	$23.87	$62.39
Truckdriver class 3 (see notes)	5/1/2026		$38.77	$23.87	$62.64

WEEKLY PAYROLL CERTIFICATION FOR PUBLIC WORKS PROJECTS

☐ Contractor or ☐ Subcontractor (Please check one) **ALL INFORMATION MUST BE COMPLETED**

CONTRACTOR ADDRESS	SUBCONTRACTOR ADDRESS	
PAYROLL NUMBER / WEEK ENDING DATE	PROJECT AND LOCATION PROJECT SERIAL # PROJECT #	

DEPARTMENT OF LABOR & INDUSTRY
COMMONWEALTH OF PENNSYLVANIA

BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGE DIVISION
7TH & FORSTER STREETS
HARRISBURG, PA 17120
1-800-932-0665

EMPLOYEE NAME	APPR. RATE (%)	WORK CLASSIFICATION	DAY AND DATE Su	M	Tu	W	Th	F	Sa	S-TIME 0-TIME	BASE HOURLY RATE	TOTAL FRINGE BENEFITS (C=Cash) (FB=Contributions)*	TOTAL DEDUCTIONS	GROSS PAY FOR PREVAILING RATE JOB(S)	CHECK #
			HOURS WORKED EACH DAY												
												C: FB:			
												C: FB:			
												C: FB:			
												C: FB:			
												C: FB:			

*SEE REVERSE SIDE

PAGE NUMBER _____ OF _____

THE NOTARIZATION MUST BE COMPLETED ON FIRST AND LAST SUBMISSIONS ONLY. ALL OTHER INFORMATION MUST BE COMPLETED WEEKLY.

*FRINGE BENEFITS EXPLANATION (FB): Bona fide benefits contribution, except those required by Federal or State Law (unemployment tax, workers' compensation, income taxes, etc.)

Please specify the type of benefits provided and contributions per hour:

1) Medical or hospital care _____
2) Pension or retirement _____
3) Life insurance _____
4) Disability _____
5) Vacation, holiday _____
6) Other (please specify) _____

CERTIFIED STATEMENT OF COMPLIANCE

1. The undersigned, having executed a contract with _____
(AWARDING AGENCY, CONTRACTOR OR SUBCONTRACTOR)

_____ for the construction of the above-identified project, acknowledges that:

(a) The prevailing wage requirements and the predetermined rates are included in the aforesaid contract.

(b) Correction of any infractions of the aforesaid conditions is the contractor's or subcontractor's responsibility.

(c) It is the contractor's responsibility to include the Prevailing Wage requirements and the predetermined rates in any subcontract or lower tier subcontract for this project.

2. The undersigned certifies that:

(a) Neither he nor his firm, nor any firm, corporation or partnership in which he or his firm has an interest is debarred by the Secretary of Labor and Industry pursuant to Section 11(e) of the PA Prevailing Wage Act, Act of August 15, 1961, P.L. 987 as amended, 43 P.S.§ 165-11(e).

(b) No part of this contract has been or will be subcontracted to any subcontractor if such subcontractor or any firm, corporation or partnership in which such subcontractor has an interest is debarred pursuant to the aforementioned statute.

3. The undersigned certifies that:

(a) the legal name and the business address of the contractor or subcontractor are: _____
_____

(b) The undersigned is: ☐ a single proprietorship ☐ a corporation organized in the state of _____
☐ a partnership ☐ other organization (describe) _____

(c) The name, title and address of the owner, partners or officers of the contractor/subcontractor are:

NAME	TITLE	ADDRESS

The willful falsification of any of the above statements may subject the contractor to civil or criminal prosecution, provided in the PA Prevailing Wage Act of August 15, 1961, P.L. 987, as amended, August 9, 1963, 43 P.S. § 165.1 through 165.17.

_____
(DATE)

_____
(SIGNATURE)

_____
(TITLE)

_____
SEAL

Taken, sworn and subscribed before me this _____ Day
of _____ A.D., _____

SECTION 00 74 00 - APPLICATION FOR PAYMENT FORMS

Documents AIA G732 and AIA G703, Application and Certificate for Payment are included for your reference. Original documents shall be used and may obtained from the American Institute of Architects

END OF SECTION 00 74 00

AIA® Document G732® – 2019

Application and Certificate for Payment, Construction Manager as Adviser Edition

TO OWNER:

PROJECT:

APPLICATION NO:

DISTRIBUTION TO:

OWNER ☐
CONSTRUCTION MANAGER ☐
ARCHITECT ☐
CONTRACTOR ☐
FIELD ☐
OTHER ☐

PERIOD TO:
CONTRACT DATE:
PROJECT NOS: / /

FROM CONTRACTOR:

VIA CONSTRUCTION MANAGER:

CONTRACT FOR:

VIA ARCHITECT:

CONTRACTOR'S APPLICATION FOR PAYMENT

Application is made for payment, as shown below, in connection with the Contract.
AIA Document G703™, Continuation Sheet, is attached.

1. ORIGINAL CONTRACT SUM..... $ _____
2. NET CHANGES IN THE WORK..... $ _____
3. CONTRACT SUM TO DATE *(Line 1 ± 2)* ..... $ _____
4. TOTAL COMPLETED AND STORED TO DATE *(Column G on G703)* ..... $ _____
5. RETAINAGE:

a. _____ % of Completed Work
(Column D + E on G703) $ _____

b. _____ % of Stored Material
(Column F on G703) $ _____

Total Retainage *(Lines 5a + 5b, or Total in Column I on G703)* ..... $ _____
6. TOTAL EARNED LESS RETAINAGE..... $ _____
(Line 4 minus Line 5 Total)
7. LESS PREVIOUS CERTIFICATES FOR PAYMENT..... _____
(Line 6 from prior Certificate)
8. CURRENT PAYMENT DUE..... $ _____
9. BALANCE TO FINISH, INCLUDING RETAINAGE

(Line 3 minus Line 6) $ _____

SUMMARY OF CHANGES IN THE WORK	ADDITIONS	DEDUCTIONS
Total changes approved in previous months by Owner	$	$
Total approved this month, including Construction Change Directives	$	$
TOTALS	$	$
NET CHANGES IN THE WORK	$	

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

CONTRACTOR:

By: _____ Date: _____

State of:
County of:
Subscribed and sworn to before me this day of
Notary Public:
My Commission expires:

CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on evaluations of the Work and the data comprising this application, the Construction Manager and Architect certify to the Owner that to the best of their knowledge, information and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the AMOUNT CERTIFIED.

AMOUNT CERTIFIED..... $ _____

(Attach explanation if amount certified differs from the amount applied. Initial all figures on this Application and on the Continuation Sheet that are changed to conform with the amount certified.)

CONSTRUCTION MANAGER:

By: _____ Date: _____

ARCHITECT: *(NOTE: If multiple contractors are responsible for performating portions of the Project, the Architect's Certification is not required.)*

By: _____ Date: _____

This Certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract.

Sample

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AIA® Document G703® – 1992

Continuation Sheet

AIA Document G702®, Application and Certificate for Payment, or G732™, Application and Certificate for Payment, Construction Manager as Adviser Edition, containing Contractor's signed certification is attached.
Use Column I on Contracts where variable retainage for line items may apply.

APPLICATION NO:
APPLICATION DATE:
PERIOD TO:
ARCHITECT'S PROJECT NO:

A	B	C	D	E	F	G		H	I
			WORK COMPLETED						
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	FROM PREVIOUS APPLICATION *(D + E)*	THIS PERIOD	MATERIALS PRESENTLY STORED *(Not in D or E)*	TOTAL COMPLETED AND STORED TO DATE *(D+E+F)*	% *(G ÷ C)*	BALANCE TO FINISH *(C – G)*	RETAINAGE *(If variable rate)*
	GRAND TOTAL								

Sample

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SECTION 00 75 00 - WAIVER OF CLAIMS AFFIDAVIT

This document is to accompany ALL Applications for Payment.

Date:

From:

Re: Application No. _____

Project Name: _____

Intending to be legally bound hereby, we certify that _____ (Contractor) waives any and all claims for additional cost and/or time arising out of, or relating to, any of the work performed as of the date of the above-referenced Application, other than those claims for which has already provided Contractor notice in writing in accordance with the requirements of the Contract Documents.

By: _____

Title: _____

Date: _____

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work performed by Owner.
4. Work performed under Owner's separate contracts.
5. Owner-furnished/Contractor-installed (OFCI) products.
6. Work sequence.
7. Contractor's use of site and premises.
8. Coordination with occupants
9. Work restrictions.
10. Specification and Drawing conventions.
11. Miscellaneous provisions

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

2. Section 017300 "Execution" for coordination of Owner-installed products.

1.3 PROJECT INFORMATION

A. Project Identification: Council Rock School District Chancellor Center Renovations.

1. Project Location: 30 North Chancellor Street, Newtown, PA 18940

2. Architect's Project Number: 25-CRSD-01.

3. Construction Manager's Project Number: 25103.01.

B. Owner: Council Rock School District

C. Owners Representative Identification: The Construction Manager (CM) for the project is Boyle Construction, Inc. 3850 Sierra Circle, Suite 400, Center Valley, PA 18034. Telephone 484.223.0726. Construction Manager has been engaged for this Project to serve as an advisor to Owner and to provide assistance in administering the Contract for construction between Owner and each Contractor, according to a separate contract between Owner and Construction Manager.

1. Chris Haller, Sr. Project Manager
   Mobile: 484.794.4439
   Email: challer@boyleconstruction.com

D. Architect: Marotta / Main Architects, 214 North Duke Street, Lancaster, PA 17602

1. Architect's Representative Identification: Christopher Peters, Donald Main, Kelsey Gibson, Amanda Strong, Camryn Bryan.

E. Architect's Consultants: Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. Structural Consultant – Joseph Barbato Assocaites, 6 Dickinson Drive, Suite 103, Chadds Ford, PA 19317

2. Civil Consultant – Barry Isett & Associates, Inc., 400 Cresson Boulevard, Suite 105A, Phoenixville, PA 19460

3. Mechanical, Plumbing & Electrical Consultant: RTM Engineering, 303 International Circle, Suite 450, Hunt Valley, MD 21030

F. Project Coordinator for Multiple Contracts: General Construction Contract.

G. Project Mechanical/Electrical/Plumbing Coordinator for Multiple Contracts:

1. HVAC Contractor shall act as mechanical/plumbing/electrical coordinator.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:
1. Site clearing and staging area preparation
2. New stormwater system and associated site work
3. Exterior light well replacement construction and associated site work
4. Renovations to the existing building

B. Project will be constructed under coordinated, concurrent multiple contracts. See Section 011250 "Multiple Contract Summary" for a list of multiple contracts, a description of work included under each of the multiple contracts, and the responsibilities of Project coordinator.

1. General/Site (GC / SC)
2. Plumbing/Fire Protection (PC / FP)
3. Mechanical (MC)
4. Electrical (EC)
5. Other as determined or required by Owner.

C. Testing:

1. Contractors are to perform all factory or shop testing, and any other testing required.
2. Contractors are to perform any field testing of electrical systems or data wiring systems.
3. Contractors are to perform testing of above or below ground pipes, ductwork, and mechanical systems including pressure, air, water, or vacuum testing required.
4. All contractor testing shall be performed in the presence of the Construction Manager and/or (if required) in the presence of the municipal agency having jurisdiction.

D. Construction Waste Management for all Project activities is by each Prime Contractor. Construction Waste Management for any demolition work and any site features is by the Contractor performing the work.

E. The Contractor responsible for installation of the systems and equipment is responsible for commissioning each system. The minimum commissioning requirements in accordance with Section 019113 and other specific project requirements, including coordination and verification, shall be the responsibility of the Contractor.

F. Contract Documents were prepared for the Project by Marotta / Main Architects, 214 North Duke Street, Lancaster, PA 17602

1.5 WORK PERFORMED UNDER OWNER'S SEPARATE CONTRACTS

A. Cooperate fully with Owner and separate Owner-hired firms and/or agencies so work may be carried out smoothly, without interfering with or delaying Work under this Contract. Coordinate the Work of this Contract with work performed under Owner's separate contracts.

1. Construction testing and special inspections will be by separate firm hired by the Owner. The Owner will procure and bear costs for **only the following:** field testing for earthwork, soil, concrete, masonry, asphalt and concrete paving, fireproofing, and structural steel.
2. Commissioning Verification Authority and HVAC testing, adjusting, and balancing (CVA/TAB) will be by separate firm hired by the Owner and will require the participation and cooperation of all contractors. The Mechanical Contractor is responsible for all pressure testing of any pipes, ductwork, or field systems and for coordinating and supporting all the testing and balancing.
3. Indoor Air Quality Testing is by Owner's independent testing agency.
4. Other contracts are at the Owner's sole discretion.

1.6 WORK SEQUENCE

A. The entire Work shall be completed in compliance with the Project phasing indicated on the Drawing Staging and Logistic Plan(s), the erosion and sedimentation control plan(s), and the milestone completion dates listed. Any deviations from these requirements shall be subject to the approval of the Construction Manager. The Owner reserves the right to enforce liquidated damages for contractor's non-compliance with any of the phasing, milestone, and substantial completion dates.

1. The Notice to Proceed will be issued as noted on the Staging and Logistic Plan(s).
2. Completion for each phase and milestones are noted on the Staging and Logistic Plan and must be strictly complied with.
3. Completion for all contracts is as follows:

a. Project Substantial Completion – 12/17/27
b. Project Final Completion – 01/14/28

B. See Staging and Logistic Plan(s) for milestone dates. The contractors' sequence and CPM schedule shall incorporate all milestone dates and comply with all dates noted therein for completing the Project. The dates provided are the milestone completion dates which will be enforced. All building systems are to be installed in compliance with the milestone dates identified on the Phasing Plans.

C. Contractors shall reference Section 014000, "Quality Control Requirements" and the Staging and Logistic Drawings for special requirements.

D. Construction work for the building shall be performed in a sequence to ensure that all building systems are systematically installed in an efficient manner. The mechanical and electrical rooms shall be constructed in an early sequence to permit rough-in by the Mechanical, Electrical, and Plumbing trades and to ensure proper operation of life safety systems in occupied areas of the building in the timeframes identified on the Staging and Logistic Plans.

E. Contractor is to clean and turn over the building in a sequence for Owner fit-out needs but not occupancy, at least one month prior to the substantial completion date or as stated on the Staging and Logistic Plans.

F. If the Notice to Proceed is delayed for any reason beyond the control of any Prime Contractor that prevents the Contractor from performing Work, all phased completion dates and milestone completion dates will be adjusted by the exact same number of days with no cost implications to the Owner.

G. If a specific milestone or phased completion date is delayed for any reason beyond the control of any Prime Contractor that prevents the Contractor from performing Work, and the delay impacts subsequent milestone

and phased completion dates, remaining milestone and phased completion dates will be adjusted by the exact same number of days with no cost implications to the Owner.

H. Liquidated damages apply for all phased completion dates and milestone completion dates shown on the Staging and Logistic Drawings.

I. All Work must be completed in accordance with the Staging and Logistic Drawings, the Project, the approved Project schedule, and in a sequence approved by the Construction Manager, Architect, and Owner.

J. The Staging and Logistic Plans identify timeframes necessary for the Owner to complete moving operations for occupancy of individual building areas. In the event of any delay in the Work that will impact the relocation or moving of Owner's operations, furnishings, or equipment, the Owner has the discretion to adjust its move or relocation milestone schedule by up to 30 days. Such action by the Owner shall be issued in writing to the contractor not less than 30 days prior to the anticipated milestone date.

1.7 OWNER-FURNISHED/ CONTRACTOR-INSTALLED (OFCI) PRODUCTS

A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable.

1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
2. Provide for delivery of Owner-furnished products to Project site.
3. Upon delivery, inspect, with Contractor present, delivered items.
   a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.
4. Obtain manufacturer's inspections, service, and warranties.
5. Inform Contractor of earliest available delivery date for Owner-furnished products.

B. Contractor's Responsibilities: The Work includes the following, as applicable:

1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
3. Receive, unload, handle, store, protect, and install Owner-furnished products.
4. Make building services connections for Owner-furnished products.
5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
6. Repair or replace Owner-furnished products damaged following receipt.

C. Owner- Furnished/Contractor-Installed (OFCI) Products:

1. Toilet Accessories, as noted elsewhere.
2. Generator and ATS.

1.8 CONTRACTOR'S USE OF SITE AND PREMISES

A. General: Contractor shall have limited use of Project site for construction operations as designated on the Staging and Logistic Plan(s) during construction period. Limit use of Project site to Work in areas or areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated. The site is surrounded by primarily residential uses and public streets. The Contractor must coordinate activities and cooperate with adjacent uses. Contractor must also schedule, coordinate, and perform construction activities to avoid disruption of ongoing operations. Contractor must schedule and perform certain work on weekends and holidays to avoid disruptions. This may include street and utility work.

B. Contractors shall place trailers and materials in designated areas as indicated on Staging and Logistic Plan(s) and in coordination with Construction Manager.

C. Burial of waste materials is not permitted.

D. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

E. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.9 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Technical Specifications are organized into Divisions and Sections using the CSI/CSC's "MasterFormat" numbering system.

1.10 MISCELLANEOUS PROVISIONS

A. Prior to acceptance as substantially complete, all general construction, all mechanical, electrical, and plumbing systems shall be complete, fully operational, tested as required, inspected by approval authorities, and certified complete.

1.11 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. On-Site Work Hours:

1. Limit work to normal business working hours as determined by Owner. Normal working hours are defined as 7:00 a.m. to 5:00 p.m., Mondays through Fridays. There can be no noise until 7:00 a.m., including but not limited to back-up/reverse alarms and/or idling vehicles/equipment.

2. Additional On-Site Work Hours may be approved in advance by the Owner, Construction Manager, and authorities having jurisdiction.

3. Site lighting must be turned off by 10:00 p.m.

C. Restricted Substances: Use of tobacco products, alcoholic beverages, vape/e-cigarettes, and other controlled substances on Project site is not permitted.

D. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site. Maintain list of approved screened personnel with Owner's representative.

E. Employee Conduct:

1. Controlled Substances: Use of tobacco products, vape/e-cigarettes, alcohol, drugs, firearms and other controlled substances on the District property is not permitted.
2. Obey posted speed limits.
3. No profanity or fighting.
4. Shirts shall be worn at all times.
5. Hard hats, safety glasses and ear protection as required by OSHA shall be utilized.
6. Trash shall be cleaned up daily.

1.12 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
   1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
   2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
   3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
   4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements of Sections in Division 00, and Division 01 General Requirements: Requirements of Sections in Division 01, apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

   1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
   2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
   3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 Contractor shall complete all work in the time period specified in the Contract. Contractor(s) shall include all necessary time, and the related cost required including but not limited to; overtime, shift work, weekends, and holidays in order to complete the work as specified within the Contract time.

END OF SECTION 01 10 00

SECTION 01 12 50 – MULTIPLE CONTRACT SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes a summary of each contract, including responsibilities for coordination and temporary facilities and controls. Construction will be bid for the following five (5) Prime Contracts:

1. General/Site Construction – BP-01
2. Plumbing/Fire Protection Construction – BP02
3. Mechanical Construction – BP-03
4. Electrical Construction – BP-04
5. Abatement Construction – BP-05

B. The building will be vacant for construction.

C. Specific requirements of each contract are also indicated in individual Specification Sections and on Drawings.

D. Related Sections include the following:

1. Division 01 Section 011000 "Contract Summary" for the Work covered by Contract Documents and for work sequence.
2. Division 01 Section 013100 "Project Management and Coordination" for general coordination requirements.
3. Division 01 Section 015000 "Temporary Facilities and Controls" for specific requirements for temporary facilities and controls.
4. Division 01 Section 019113 “General Commissioning Requirements” for additional information and procedures.

E. DEFINITIONS

1. Permanent Enclosure: As determined by Architect and/or Construction Manager, permanent is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial (watertight and insulated) temporary closures.

   a. Substantial temporary closures shall at a minimum be 5/8” exterior plywood within wood frame, with minimum of 6” thick batt insulation.

2. Coordinate: The term “coordinate” means “to cooperate with related trades to furnish and install all connections between the trades in correct sequence size and location to create a complete system ready for intended use.”

3. Verify: The term “verify” means “to measure, investigate, review, test, check the accuracy or correctness of and prove by demonstration, evidence, or testimony the location, size, dimension and condition of an item.”

4. Furnish: The term “furnish” is used to mean “supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations.”

5. Install: The term “install” is used to describe operations at the project site including the actual “unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, performing, coordinating with other trades, protecting, cleaning, and similar activities.”

6. Provide: The term “provide” means “to furnish and install, complete and ready for the intended use.”

1.3 COORDINATION

A. Project Coordinator shall be responsible for coordination between the General Construction Contract, Plumbing/Fire Protection Contract, HVAC (also referenced as Mechanical) Contract, Electrical Contract and Owner-provided services by Owner’s forces and work by other entities on site.

1. General Construction Contractor shall act as and assume responsibilities of Project Coordinator or Lead Contractor which are designated throughout the Contract Documents. The General Contractor shall be the full-time Project Coordinator and shall be experienced in Administration and Supervision of building construction activities, including Mechanical, Electrical, Plumbing/Fire Protection work.

B. HVAC, Plumbing/Fire Protection, & Electrical Coordinators, who shall be subordinate to Project Coordinator, shall be responsible for coordination between the Plumbing/Fire Protection Contract, HVAC Contract, and Electrical Contract.

C. The HVAC Contractor shall be responsible for the assembly of coordination drawings for himself, and the inclusion of coordination drawings provided by the Electrical and Plumbing/Fire Protection Contractors.

D. The HVAC (Mechanical) Contractor shall be the primary M/E/P/FP coordinator and shall be responsible for the preparation of AutoCAD electronic coordination drawings between HVAC, Plumbing/Fire Protection, and Electrical trades. The Plumbing/Fire Protection and Electrical Contractors shall provide such information electronically to fully coordinate their work with that of the other primes and in the format requested by the HVAC Contractor. All Prime Contractors shall cooperate and be responsible for preparation and compliance with coordination drawings.

E. GC shall coordinate all work in accordance with project phasing requirements and scheduled activities of all other contractors. GC shall perform cutting and patching of all roofing materials including concrete and metal deck. Any structural reinforcement required is by the General Contractor.

F. The MC, PC/FPC and EC shall be responsible for providing and maintaining watertight conditions for all roof and building envelope penetrations and openings that are part of their scope.

G. All Prime Contractors shall field verify existing conditions prior to submitting a bid, and prior to fabrication.

H. Existing elevator is to remain; there is no elevator modernization as per of these contracts. Use of the elevator by contractors during demolition and/or construction is not permitted.

1.4 PROJECT COORDINATOR RESPONSIBILITIES

A. Project Coordinator: Full-time Project Coordinator shall be experienced in administration and supervision of building construction, including HVAC, plumbing, and electrical work.

1. Coordination activities of Project Coordinator include, but are not limited to, the following:
   a. Provide typical overall coordination of the Work.
   b. Provide overall coordination to project phasing.
   c. Coordinate shared access to workspaces.
   d. Coordinate product selections for compatibility.
   e. Provide overall coordination of temporary facilities and controls.
   f. Coordinate, schedule, and approve interruptions of permanent and temporary utilities, including those necessary to make connections for temporary services.

g. Coordinate construction and operations of the Work with work performed by each Contract and Owners subcontractors.
h. Prepare Coordination Drawings to coordinate work by more than one contract except for HVAC, electrical, and plumbing/fire protection coordination drawings which are the responsibility of the respective Contractors and primarily the HVAC Contractor.
    i. Oversee and review preparation of Coordination Drawings to ensure contract requirements are met and properly sequenced.
    ii. Implement the requirements of the Coordination Drawings.
i. Coordinate sequencing and scheduling of the Work. Include the following:
    i. Initial Coordination Meeting: At earliest possible date, arrange and conduct a meeting with contractors for sequencing and coordinating the Work; negotiate reasonable adjustments to schedules.
    ii. Prepare a combined Contractor's Construction Schedule and monthly updates for entire Project. Base schedule on Preliminary Construction Schedule. Secure time commitments for performing critical construction activities from contractors. Show activities of each contract on a separate sheet. Prepare a summary sheet indicating combined construction activities of contracts.
    iii. Submit schedules to Construction Manager for approval.
    iv. Prepare recovery schedules as needed.
    v. Distribute copies of approved schedules to Architect, Construction Manager, Owner, and contractors.
j. Provide photographic and vide documentation of existing conditions, work as it progresses and at completion.
k. Provide quality-assurance and quality-control services specified in Section 014000 "Quality Requirements."
l. Coordinate sequence of activities to accommodate tests and inspections, and coordinate schedule of tests and inspections. including those required by local, county, state, and federal agencies.
m. Provide information necessary to adjust, move, or relocate existing utility structures affected by construction.
n. Perform field engineering, construction layout, and locate existing permanent benchmarks and control points. Provide similar reference points and establish permanent benchmarks, control points, and elevations on project site for use by other prime contractors and all trades.
o. Provide field surveys of in-progress construction and site work and final property survey.
p. Provide progress cleaning of common areas and coordinate progress cleaning of areas or pieces of equipment where more than one contractor has worked. Progress cleaning of building and site shall be performed on a daily basis. Site cleaning shall include removal of mud and debris from all areas and in particular all sidewalks and streets.
q. Provide final cleaning of building and site. Work shall include preparations for commercial traffic (final polishing) and waxing of traffic surfaces after Project Coordinator has otherwise performed final cleaning.
r. Coordinate cutting and patching.
s. Coordinate protection of the Work.
t. Coordinate firestopping.
u. Coordinate completion of interrelated punch list items.
v. Coordinate final cleaning of areas of Work.
w. Construction Manager will coordinate preparation Record Documents if information from more than one contractor is to be integrated with information from other contractors to form one combined record.
x. Print and submit Record Documents if installations by more than one contractor are indicated on the same Contract Drawing or Shop Drawing.
y. Construction Manager will collect Record Specification Sections from other contractors, collate Sections into numeric order, and submit complete set.
z. Construction Manager will coordinate preparation of operation and maintenance manuals if information from more than one contractor is to be integrated with information from other contractors to form one combined record.

aa. Before the concrete floor slab in poured, create a rough-in drawing indicating location of under slab and in-wall conduits and utilities related to Work by Owner's Vendors. Intent: Vendors' Work requires coordination with Prime Contractors' Work.
bb. Coordinate work of all Owner vendors.
cc. Provide common-use field office for use by all personnel engaged in construction activities. Field office shall include two separate office spaces, one for Construction Manager use and a large meeting space suitable for up to 20 people.

B. HVAC, Electrical, Plumbing/Fire Protection (MEP&FP) Coordinators: Full-time HVAC, Plumbing, and Electrical Coordinators shall be experienced in coordination of M/E/P/FP construction, including coordination of type of operations required for this Project.

1. Coordination activities of HVAC, Electrical, and Plumbing/Fire Protection Coordinators include, but are not limited to, the following:

a. Schedule and sequence HVAC, Electrical, and Plumbing/Fire Protection activities.
b. Coordinate sharing access to workspaces by HVAC, Electrical, and Plumbing/Fire Protection contractors.
c. Coordinate integration of HVAC, Electrical, and Plumbing/Fire Protection work into limited spaces.
d. Coordinate protection of HVAC, Electrical, and Plumbing/ Fire Protection contractors' work.
e. Coordinate cutting and patching for HVAC, Electrical, and Plumbing/Fire Protection work.
f. Take the lead and be responsible for HVAC, Electrical, and Plumbing/Fire Protection Coordination Drawings. Coordination drawings must be reviewed with Project Coordinator for finish ceiling heights. Drawings shall coordinate and include but not be limited to the following components:

i. Structural System limits.
ii. Electrical Systems.
iii. Fire Protection Systems.
iv. Mechanical piping and ductwork.
v. Storm and sanitary piping.
vi. Date and telecommunications.

g. Coordinate tests and inspections for HVAC , electrical and plumbing work
h. Coordinate HVAC, Electrical, and Plumbing/Fire Protection temporary services and facilities.
i. Coordinate with all utility companies with bringing all utilities into the site (i.e. electric, cable, water, sewer, etc.)

1.5 GENERAL PARAMETERS FOR HVAC, ELECTRICAL, AND PLUMBING/FIRE PROTECTION COORDINATION DRAWINGS

A. HVAC Contractor is responsible for integrating Coordination Drawing.

B. Coordination drawings must be prepared electronically and in ACAD format.

C. Comply with the requirements for Coordination Drawings as specified in the Division 01 Section "Project Management and Coordination."

D. HVAC Contractor shall within 20 days of a fully executed contract distribute layout drawings in CAD format to all Contractors. Layout drawings shall include but not be limited to the following:

1. Columns and beams.
2. Ceiling heights.
3. Ceiling dimensional layouts per the reflected ceiling plans.
4. Ceiling grid.
5. Coordination drawings of ceiling cavities and mechanical rooms demonstrating the spatial relationships and necessary clearances within the available space above ceilings and within rooms for HVAC, Electrical, and Plumbing/Fire Protection structural systems.

6. Wall to wall dimensions.
7. Partition layouts.
8. Windows, doors and other openings
9. Heights from ceiling to structural components.
10. Dimensions from column centerlines.
11. Other appropriate building features.

E. Upon receipt of layout CAD files, each contractor shall proceed immediately and independently to indicate their work as overlays on the CAD files. This work shall be done within the next 4 days unless otherwise agreed upon by the Construction Manager.

F. The drawing layout prepared by each contractor shall be transmitted to HVAC contractor and other contractors for comment and adjustments.

G. Coordination meetings will be held, and all contractors will be required to attend and cooperate. Changes shall be made as requested by HVAC contractor. This process shall take up to 30 days.

H. Contractors shall also prepare additional CAD drawings as necessary to adequately and completely show the intended routing and layout of their work. Additional drawings may include riser diagrams, flow sheets, elevations, details, sections, isometric layouts, etc. as determined by the HVAC contractor and the Architect.

I. The Prime Contractor responsible for Work in each of the following categories shall prepare or arrange for preparation of Coordination Drawings for the following systems:

1. HVAC systems
2. Plumbing and Fire protection systems including sprinklers
3. Electrical systems
4. Openings and sleeves in structural slabs
5. Ceiling systems.

J. Include on Coordination Drawings the information listed below for each of the following categories of Work:

1. Mechanical Systems:
    a. Sizes and bottom/headroom elevations of new electric unit heaters.
    b. Weights of each unit and the proposed attachment structure.
    c. Locations of major components, including dampers, valves, diffusers, cleanouts, and electrical distribution equipment.

2. Electrical Systems:
    a. Horizontal and vertical runs of conduit 1-1/4 inch diameter and larger
    b. Light fixture locations and mounting type.
    c. Smoke and Carbon Monoxide detector locations.
    d. Panel boards, switch boards, switch gear, transformers, busways, generator, and motor control center.
    e. Exit signs, strobe/horn, and emergency battery pack locations
    f. Pull box dimensioned from column centerlines.

3. Fire Protection Systems:
    a. Sizes and centerline elevations of sprinkler piping.
    b. Sprinkler head locations with elevations referenced to ceiling heights.
    Locations of major valves.

4. Structural Work:
    a. Openings and sleeve locations required in slabs, walls, beams, and other structural elements, including required openings not indicated on Contract Documents.
    b. Slab edge locations.

5. Elevated floor and roof Structure, Reflected Ceiling:
    a. Locations and attachment methods of mechanical, fire protection and electrical items, including grilles, registers, diffusers, light fixtures, smoke detectors, sprinkler heads, exit signs, speakers, and other items.

b. Conform to locations indicated on Contract Drawings to the minimum extent possible.
c. Indicate positions relative to acoustical ceiling grid where applicable.

K. HVAC contractor shall put together all information for final preparation and submission of integrated coordination drawings. This shall be done within 60 days of a fully executed contract for all areas of the building unless otherwise approved by Owner.

L. Any Contractor not complying with any of the coordination requirements including the timelines will be assessed $600.00 for each day that Contractor is not in compliance.

1.6 GENERAL REQUIREMENTS OF CONTRACTS

A. Extent of Contract: Unless the Contract Documents contain a more specific description of the Work, names, and terminology on Drawings and in Specification Sections determine which contract includes a specific element of Project.

1. Unless otherwise indicated, the Work described in this Section for each contract shall be complete systems and assemblies, including products, components, accessories, and installation required by the Contract Documents.
2. To the extent that the work of all of the contracts represents a complete and integrated whole, each prime contractor shall become thoroughly familiar with all of the construction documents. Work of a particular contract shall be substantially located on the documents referenced below, but such references do not relieve each contractor for responsibility to provide work in compliance with requirements on all of the documents as follows:
   i. Information contained on any construction document shall be enforceable on each contractor as indicated on drawings, by reference to contractor designations (GC, PC, HVAC/MC and EC).
   ii. Dimensional information on the Architectural drawings that relates to the work of a particular contract shall be the responsibility of that contractor to install the item where located.
   iii. In the absence of specific dimensional information on the Architectural plans for exposed items provided by the HVAC, Plumbing and Electrical Contracts, consult Architect for decisional requirements before installing exposed item.
   iv. In cases of conflicts, assignment of responsibilities shall be at the sole interpretation of the Architect.
3. Local custom and trade-union jurisdictional settlements do not control the scope of the Work of each contract. When a potential jurisdictional dispute or similar interruption of work is first identified or threatened, affected contractors shall negotiate a reasonable settlement to avoid or minimize interruption and delays.
4. Trenches, other excavation and backfill outside the Building, for the Work of each contract shall be by the contractor performing the Work. Also refer to 1.7 – “Multiple Prime Coordination Clarifications” later in this Section.
5. Trenches are not to be left open unless they are enclosed by fencing or barriers.
6. Blocking, backing panels, sleeves, and metal fabrication supports for the work of each contract shall be the work of each contract for its own work.
7. Furnishing of access panels for the work of each contract shall be the work of each contract for its own work. Installation and finishing of access panels shall be the work of the General Contractor.
8. Work involving a structural element shall be completed by the General Contractor.
9. Ground Mounted Equipment pads for the work of each contract shall be the work of each contractor for its own work, including excavation, trenching, backfill and subbase, EXCEPT for the generator pad and the chiller pad.
10. The generator pad and the chiller pad shall be the work of the General Contractor in accordance with the Structural Drawings.
11. Roof Mounted Equipment Curbs for the work of Each Contract shall be the work of each contract. Flashing of Roof Mounted Curbs is by General Contractor.
12. Painting for the work of each contract shall be the work of the General Contractor.
13. Cutting and Patching – Provided under each contract for its own work. Exterior Patching of Penetrations through exterior assemblies shall be by General Contractor. Patching in finished surfaces to be the work of the General Contractor.
14. Through-penetration fire-stopping and thermal insulation for the work of each contract shall be provided by the Prime Contractor for each contract. The General Contractor.shall provide and install

through-penetration fire-stopping and thermal insulation for architectural joints, head-of-wall, and leftovers.

15. Noise Control: Each contract shall be responsible to control noise that may be disruptive the operation of the adjacent residential properties. Coordinate with Owner in advance regarding timing of noisy work. Use of gasoline powered equipment shall be limited to designated working hours. Alternatively use electric or compressed air powered equipment.
16. Dust and Smoke Control: Each contractor shall be responsible to control dust and smoke production and distribution. Do not do work that produces dust, smoke or other airborne particulates without adequate control facilities. Protections include but are not limited to:
    a. HEPA vacuums to collect dust.
    b. Temporary dust enclosure.
    c. Negatively pressurize the space and exhaust to a location not disruptive to the Owner.
    d. Employ water spray for concrete saws.
    e. Comply with all current OSHA requirements for smoke and dust control.
17. Protection of Ceilings: Each contract shall be responsible to remove, carefully store and reinstall ceilings in rooms with above ceiling work for that contract where the ceiling in that room is indicated as existing to remain or has been newly installed. Where ceilings are damaged, the cost of replacement or repairs will be divided equally between prime contractors with above ceiling work in that room.
    a. Where a Prime Contractor requires extended access above a newly installed ceiling, that Contractor shall coordinate with the GC to not install the permanent ceiling panels, and that contractor shall provide and install temporary ceiling panels in place of the permanent ceiling panels. Temporary ceiling panels can be salvaged from demolition work (if applicable), or reused from some other source, or may be the lowest cost panel available to that Contractor. When access is no longer required, that Contractor shall remove the temporary panels and coordinate the permanent installation of ceiling tiles with the GC.
18. Concealed sealants for the Work of each contract shall be provided by each contract for its own Work. Comply with Division 07 requirements for sealants.
19. Contractors' Startup Construction Schedule – Within ten (10) working days after startup horizontal bar-chart-type construction schedule submittal has been received from Project coordinator, submit a matching startup horizontal bar-chart schedule showing construction operations sequenced and coordinated with overall construction.
    a. Rough-ins, backfill and compact any trenches.

B. Substitutions: Each contractor shall cooperate with other contractors involved to coordinate approved substitutions with remainder of the Work.

1. The General Construction Contract shall coordinate applicable substitutions by other contractors.
2. Substitutions will not be permitted after contract award, except as noted in Section 01 25 00 “Substitution Procedures”.
    a. All submittals shall be copied to the Project Coordinator.

C. Temporary Facilities and Controls: In addition to specific responsibilities for temporary facilities and controls indicated in this section and in Division 01 Section "Temporary Facilities and Controls," each contractor is responsible for the following:

1. Building Permit (Owner responsible for securing permit and cost for permit).
2. Installation, operation, maintenance, and removal of each temporary facility necessary for its own normal construction activity, and costs and use charges associated with each facility, except as otherwise provided for in this Section.
3. Each Prime Contractor shall provide their own heating and related fuel to their respective temporary field offices.
4. Electrical Contractor to install and connect temporary power and meter to all Prime Contractors’ and Construction Manager field offices. Utility charges to be paid for by Owner.
5. Plug-in electric power cords and extension cords, supplementary plug-in task lighting, and special lighting necessary exclusively for its own activities.
6. Temporary enclosures for its own construction activities.
7. Staging and scaffolding for its own construction activities.

8. General hoisting facilities for its own construction activities, up to 2 tons (2000 kg).
9. Waste disposal facilities, including collection and legal disposal of its own hazardous, dangerous, unsanitary, or other harmful waste materials.
10. Progress cleaning of work areas affected by its operations on a daily basis.
11. Secure lockup of its own tools, materials, and equipment.
12. Construction aids and miscellaneous services and facilities necessary exclusively for its own construction activities.
13. Generators for powering welders.
14. Generators for equipment requiring three phase power. This shall also include temporary power for 3-phase permanent equipment that must be tested before connection to and/or availability of permanent power supply.

D. Temporary Heating, Cooling and Ventilation

1. Refer to Paragraph 1.11 elsewhere in this Section for additional information.
2. The Mechanical Contractor will perform filter changes throughout demolition and construction.

E. Use Charges – Comply with the following:

1. Sewer Service – Cost for sewer service use by all parties engaged in construction activities at Project site will be provided and paid for by Owner.
2. Water Service – Cost for temporary water service from owners existing water service, for water used by all entities engaged in construction activities at Project site will be provided and paid for by the Owner.
3. Electric Power Service – Cost for electric power service from Owners existing electric service, for electricity used by all entities engaged in construction activities at Project site (excluding temporary HVAC) will be provided and paid for by the Owner.
4. Fuel Service – Each contractor will be responsible for providing and paying for all fuel for its own work and contractor using the equipment consuming the fuel.
5. Gas Service – Cost for gas service from Owners existing gas service, for power used by all entities engaged in construction activities at Project site (excluding temporary HVAC) will be provided and paid for by the Owner.

F. For each system, the Contractor responsible for installation of the systems and equipment is responsible to start up, check out, train, and support the Owner's Independent Commissioning Verification and Testing and Balancing. The minimum commissioning requirements in accordance with Division 01 and other specific project requirements, including coordination and verification, shall be the responsibility of the Contractor. Prime Contractors shall perform startup, checkout, testing, and training of their respective Work in accordance with the manufacturers' recommendations and in conjunction with Owner's Commissioning Verification and Testing Agent(s). Independent Commissioning Verification and TAB shall be performed by Owner-retained agencies. Contractors shall provide all labor and support required for commissioning activities and corrective actions.

1.7 MULTIPLE PRIME COORDINATION CLARIFICATIONS

A. The Prime Contractor requiring the lintel shall furnish and install all lintels and structural supports required for openings and recesses in new and existing construction to allow the passage of the Work of his Contract and the Work of the General, Plumbing/Fire Protection, HVAC, and Electrical Prime Contracts. Refer to Structural Drawings for lintel schedule.

B. To the extent that the work of all of the contracts represents a complete and integrated whole, each Prime Contractor shall become thoroughly familiar with all of the construction documents. Work of a particular contract shall be substantially located on the documents referenced below, but such references do not relieve each Contractor for responsibility to provide work in compliance with requirements on all of the documents as follows:

1. Information contained on any construction document shall be enforceable on each Contractor as indicated on drawings, by reference to contractor designations (GC, PC/FP, MC and EC).

2. Dimensional information on the Architectural, MEP/FP and Site drawings that relates to the work of a particular contract shall be the responsibility of that Contractor to install the item where located. In the absence of specific dimensional information on the Architectural, MEP/FP and Site plans for exposed items provided by the HVAC, Plumbing, Fire Protection and Electrical Contracts, consult Architect, Engineer, or Construction Manager for decisional requirements before installing exposed item.

3. In case of conflicts, assignment of responsibilities shall be at the sole interpretation of the Architect, Engineer, or Construction Manager.

C. General Contractor shall provide chases and openings 12” x 12” or larger for equipment in new and existing construction, including all roof areas, as directed, supervised, located, marked, and configured within the project structure, by the Plumbing, HVAC, and Electrical Prime Contractors' personnel onsite. These openings shall be sealed by the prime contractor requiring the opening until permanent equipment is in place and flashings are installed by the GC. All sleeves, conduits, and sealing of the same shall be furnished and installed by the prime contractor that requires the access for installation of systems. Roofing Subcontractor to the GC shall perform cutting and patching of roof materials as directed by the other Prime Contractors for the implementation of their work, including infilling of insulation and/or thermal and moisture barriers.

D. The Prime Contractors shall be responsible to seal all roof openings. GC and Roofing Subcontractor are responsible up to curb flashings. The HVAC Contractor shall layout all openings and curbs and shall furnish all roof curbs to GC for installation. GC shall provide all blocking and accessories to install curb(s). Roofing subcontractor will provide all permanent roofing and flashing to the curbs. HVAC Contractor is responsible to seal any temporary or permanent openings and install new equipment keeping the opening watertight at all times.

E. During placement of concrete slabs, each Prime Contractor that has rough-in requirements in the slab shall provide on-site personnel while slabs are being poured to direct, supervise, locate, mark, and configure rough-in requirements. Sleeves required for floor, wall, and roof penetrations shall be furnished and installed by the Prime Contractor(s) that require the sleeves. Sleeves to be installed in new concrete slabs shall be installed by the Prime Contractor(s) that require the sleeves, prior to new slab placement. The Prime Contractor using the sleeves is responsible for installing sealant, fire-safing, and/or escutcheons necessary for a finished installation.

F. Prime Contractors who fail to properly coordinate their work in new construction work and whose work requires an opening, or recess, in completed construction shall be responsible to provide that alteration; to furnish and install lintels and structural supports required; and to patch the construction to match the completed unaltered.

G. General Contractor shall apply sealant around wall mounted outside air intake louvers provided and installed by the HVAC Contractor.

H. General Contractor shall provide sanitary and storm sewer system from a point five feet outside of the foundation wall of the building, unless noted otherwise. Plumbing/Fire Protection Contractor shall provide sanitary and storm system within building, including underground to a point five feet outside the building perimeter, unless noted otherwise, and shall make final connection to storm and sanitary system.

1. General Contractor shall provide exterior stormwater conveyance including exterior gutters, downspouts, and leaders to below grade.
2. General Contractor shall provide below grade drainage as shown on the Civil drawings.

I. New 8-inch combined water service: Plumbing Contractor shall provide and install tap and pipe from the main, through the wall, under the new slab, to the domestic/fire protection split. The Plumbing Contractor shall provide and install both backflow preventers. The General Contractor shall restore surfaces from a point 5 feet outside the building, frames the wall opening, and pours the slab on grade around the sleeve. The Owner shall pay the municipal authority fees.

J. New 8-inch combined water service: Plumbing Contractor shall tap and pipe from the main, through the wall, under the new slab, to the domestic/fire protection split. The Plumbing Contractor shall provide and install both backflow preventers. The Plumbing Contractor shall make the final connection to the water supply system. The General Contractor shall restore surfaces from a point 5 feet outside the building, frame the

wall opening, and pour the slab on grade around the sleeve. The Owner shall pay the municipal authority fees.

K. General Contractor's responsibilities for gas service shall be excavation/trenching, installation of screening bed for gas piping and backfill of any trenching or related excavation for the gas line installation. All work to be in accordance with PECO specifications and requirements.

L. Plumbing Contractor shall provide all gas service piping throughout building and shall make final connections to equipment.

M. The Electrical Contractor shall disconnect lighting and other electrical and low-voltage equipment prior to demolition.

N. The Electrical Contractor shall lock out and tag circuit breakers and switches and shall check cables and wires to ensure they are de-energized to ground potential before Work begins

O. Plumbing Contractor shall provide devices such as hose bibbs, washing machine outlet box, water conditioner, water filter, and pet cock for icemaker.

P. Interior concrete bases and pads required for plumbing, fire suppression, heating, ventilation, and air conditioning, and electrical equipment shall be provided by the contractor installing the equipment unless noted otherwise.

Q. General Contractor shall provide the generator pad and the chiller pad.. The General Contractor will place the new concrete around sleeves furnished by the other prime contractors.

R. Exterior light pole bases and transformer pads are by the Electrical Contractor.

S. HVAC and Plumbing Contractors shall provide control interlock wiring for their associated system equipment.

T. Electrical Contractor shall provide disconnect switches for HVAC and Plumbing system equipment except where such items are factory installed as an integral part of the equipment.

U. Electrical Contractor shall provide manual motor starters, or magnetic motor starters, for HVAC and Plumbing equipment except where such equipment is provided with factory installed starters as an integral part of the equipment or equipment control panel. Variable frequency drives shall be an integral part of HVAC equipment and HVAC variable speed pumping package.

V. Electrical Contractor shall provide fuses for disconnects and disconnect/starter switches. HVAC and Plumbing Contractors shall furnish the Electrical Contractor with required motor data to properly size and select fuses and overload protection in accordance with the National Electrical Code requirements. HVAC and Plumbing Contractors shall furnish to the Electrical Contractor the equipment manufacturers' circuit protection data.

W. Where fireproofing is indicated for the project, each Prime Contractor shall install clips, hangers, supports, sleeves, runners, and other items required prior to installation of fireproofing. Each Prime Contractor shall protect fireproofing material; damages to fireproofing shall be repaired by the General Contractor and charged to the Prime Contractor responsible for the damage; this includes items installed out of sequence.

X. Plumbing/Fire Protection, HVAC, and Electrical Contractors shall provide miscellaneous steel members for support of hanging systems installed under their contract and shall reinforce joists for non-panel point concentrated loads. When run parallel to joists, hanging systems shall be supported from steel installed perpendicular to joists and spanning a minimum of three (3) joists. All miscellaneous steel required shall be provided by contractor installing the systems under their contract; do not use joists for support. Supporting from metal roof deck and deck systems is prohibited.

Y. General Contractor shall provide door louvers.

Z. HVAC Contractor shall set controls, panelboards, and appurtenances installed in pipe lines and ductwork and shall provide control wiring.

AA. Electrical Contractor shall provide devices, wiring within casework, and final connections for educational casework as provided for in the Contract Documents.

BB. Plumbing Contractor to provide all fixtures, traps, etc. to provide all installation and final connections of sinks, faucets, and fittings. Coordinate this work with the General Contractor as provided in the contract documents.

CC. Fire Protection Contractor to coordinate tie-in of sprinkler system to fire alarm system with Electrical Contractor. Plumbing Contractor to provide flow and tamper switches for connection to fire alarm system.

DD. Plumbing, HVAC, and Electrical Prime Contracts shall furnish any access panels which are required for access to their work. Coordinate opening requirements with the General Contractor for installation by GC.

EE. General Contractor to furnish and install all exterior vents and louvers.

FF. The disconnection and/or reconnection of existing equipment shall be by the Plumbing/Fire Protection / HVAC / Electrical Contractor as applicable.

GG. General Contractor to clean and seal flooring per manufacturer's recommendations, as indicated in the Construction Documents. Refer to Drawings and Specifications.

HH. All roofing work will be performed by GC:

1. GC shall coordinate all work in accordance with project phasing requirements and scheduled activities of all other contractors. GC shall perform cutting and patching of all roofing materials including concrete and metal deck. Any structural reinforcement required is by the General Contractor.

2. The GC shall be responsible to maintain watertight conditions between the roof and curbs, pipes and conduits for providing temporary enclosures that are watertight for all roof penetrations and openings that are part of their scope in order to maintain watertight conditions beyond the roofer's flashings. GC is responsible to install all HVAC curbs and required conduits for both permanent and temporary flashing. HVAC to finish curbs and layout. GC responsible for up to curb flashing.

3. Reference Article 1.7.B of this Section for additional requirements.

1.8 MULTIPLE PRIME COORDINATION FOR ELECTRONIC/ELECTRIC TEMPERATURE CONTROLS, Division 23

A. The HVAC Contractor is defined herein to include the work of the Mechanical Contractor, H.C., M.C., ATC Sub-Contractor, and/or BAS Contractor.

B. The HVAC Contractor shall provide wiring, fiber, and data cable between all Ethernet Network Controllers Standalone Digital Control Units, workstations, software, sensors, transducers, relays, valves, dampers, damper operators, control panels, and other accessory equipment, along with a complete system of electrical interlocking wiring to fill the intent of the specification and provide for a complete and operable system as specified in Division 23.

C. The Electrical Contractor shall provide electric power wiring to new plumbing and HVAC equipment. HVAC Contractor shall provide electric power wiring and control wiring for ATC equipment and devices.

D. The Electrical Contractor shall furnish duct smoke detectors. The Mechanical Contractor shall install duct detectors in ducts. The Electrical Contractor shall wire the duct smoke detectors to the fire alarm system. The Electrical Contractor shall provide fire alarm relays adjacent to the mechanical equipment, and the Mechanical Contractor shall wire to the ATC/BAS system to de-energize the fan.

E. The Electrical Contractor shall provide the kW/KWH transducer specified at each secondary metering location. The HVAC contractor shall provide control wiring to the points specified.

F. The Electrical Contractor shall provide auxiliary contacts on generator/transfer switch as required in the points list in Division 23. The HVAC Contractor shall provide control wiring to the points.

G. The HVAC Contractor shall provide all interlock wiring specific to equipment.

1.9 Work in ALL Contracts include, but is not limited to, the following:

A. Permits and Inspections: The plans will be submitted to Council Rock School District for a plan review by the Architect. Upon award, each successful prime contractor must complete any applicable permit forms (and business licenses if required) and submit to the Council Rock School District and obtain the approved plans. Building permit and inspection fees will be paid for by the Owner. Any additional costs incurred due to failed inspections shall be paid by the prime contractor. Any required contractor or business license fees required by the municipality are to be paid for by each prime contractor.

B. See the “Milestone Date Schedule” for mandatory completion dates through the duration of the project. Schedule must be held. There will be no exceptions.

C. Each prime contractor is responsible for importing any and all material required for their work including cost of the material, hauling placement and compaction.

D. All utility company tap-in or new service fees such as electric; natural gas ; sanitary sewer and water service are to be paid for by the Owner.

E. Construction Testing and Special Inspections services shall be provided by the Owner.

F. HVAC Testing, Adjusting and Balancing and Commissioning Verification shall be provided by the Owner. Each Contractor is responsible for the commissioning of their equipment and systems. Refer to 1.6F in this Section.

G. Each prime contractor is responsible for offsite storage of their own materials. Onsite storage may only be permitted as space allows. Construction Manager will approve storage locations. Construction Manager reserves the right to deny use of storage.

H. General Contractor (GC) shall be responsible for drinking and washing facilities as required.

I. General Contractor (GC) shall provide all temporary sanitary facilities for all prime trades to use.

J. Each prime contractor shall be responsible for their own daily clean-up.

K. Each prime contractor shall remove all packaging or protective film on all of their finishes just prior to final cleaning. GC shall provide all final cleaning for move-in condition by the Owner. Final cleaning includes but is not limited to: removal of all debris; vacuuming of all floors; wet cleaning, stripping and 2-coats of wax on all vinyl floors; ceramic floors mopped and cleaned accordingly; all fixtures cleaned and free of dust; all cabinets vacuumed of any dust or debris; all horizontal services wiped cleaned; all windows (glass and frames) cleaned inside and outside; all exterior surfaces cleaned and dirt free including sweeping and power washing as required.

L. Each prime contractor is responsible for their own as-built drawings.

M. Each and all primes are responsible for all drawings for coordination and layout purposes.

N. Each Prime contractor is responsible for all temporary barricades, pedestrian protection, lockable storage areas, etc.as it pertains to their work. As Project Coordinator, GC will coordinate these efforts. General Contractor is responsible for all temporary barricades, pedestrian protection, etc. for all phases of work as it relates to employees and visitors entering, exiting and traveling throughout the building and outside the building.

O. Each Prime Contractor is responsible for all required concrete foundation and or pads for outdoor ground set mechanical equipment including excavation, trenching, backfill and subbase. EXCEPTION: The General Contractor is responsible for the generator pad and the chiller pad.

1.10 GENERAL CONSTRUCTION CONTRACT (GC)

A. The Work under the General Construction Contract includes, but is not limited to, the following:

1. Work not identified as work under other contracts. Add all work shown on structural plans, all duct chases and platforms
2. Selective general construction demolition as described in drawings and all other demolition not noted by others.
3. All site related work, including but not limited to bollards, ramps, railings, signage, fencing, striping, etc. as indicated on the drawings.
4. Construction waste management for the entire Project. GC to coordinate project waste disposal and dumpster removal.
5. Site improvements, including roadways, parking lots, site development furnishings and equipment, pedestrian paving, lawns and landscaping.
6. Site utility piping and trenches shown on site drawings or referenced from site drawings.
7. Excavation and backfill of all site and utility trenches unless noted as responsibility of other contractors.
8. Site water supply and distribution.
9. Site sanitary sewer, sanitary pump and pump connections and accessories.
10. Site storm sewer.
11. Asphalt and concrete paving and curbs.
12. Site signage as indicated.
13. Demolition of existing building components as noted and required for renovations.
14. Foundations, including footings, foundation walls.
15. Slabs-on-grade, including earthwork, sub drainage systems, and insulation.
16. Below-grade building construction, including excavation, backfill, and thermal and moisture protection.
17. Superstructure, including floor and roof construction.
18. Penetrations through existing structural elements. GC to provide engineered, signed and sealed drawings.
19. Insulation and fireproofing.
20. Exterior closures, including walls, doors, windows, sheathing, thermal and moisture protection and exterior finishes.
21. Masonry work, rough and finish carpentry.
22. Framing for all roof and floor openings and supported equipment, including coordination for all roof work.
23. All roofing, roof drains, roofing accessories, installation of HVAC roof curbs, all blocking required for installation.
24. Interior construction, including partitions, doors (wood, hollow metal, aluminum, etc.), fittings, finish, hardware, and glazing.
25. General floor flash patching and leveling. If excessive amounts of work are uncovered, refer to Unit Prices, Section 01 2200.
26. Fire suppression specialties and fire-rated framing and glass.
27. Stairs, including railings and finishes.
28. Finishes.
29. Lockers.
30. Furnishings, including casework, specialty casework, and window treatments.
31. Temporary fire protection including fire extinguishers.
32. Temporary closure of openings.
33. Openings including windows, doors, and hardware. Provide all aluminum windows, storefronts, entrance doors, curtainwalls, glass, and glazing.
34. Specialties.
35. Starting, commissioning, adjusting, and training of all General Construction systems and equipment in accordance with manufacturers' recommendations and in conjunction with Owner's Commissioning Verification and Testing Agent(s).
36. Provide all drywall, metal studs, insulation, wood, and acoustical ceilings and grid.

37. Provide all expansion joints and covers.
38. Installation of Owner-furnished items as noted on the plans and specifications.
39. Provide all blocking necessary to install Owner-furnished items.
40. GC is responsible for all caulking and sealing of all penetrations, expansion joints and transitions between dissimilar materials.
41. GC is responsible for all roofing, waterproofing, and damp proofing. Includes cutting and patching for MC provided roof top equipment.
42. GC is responsible to protect all adjoining properties and Owner's existing property exterior to the building. The GC shall video the building and property prior to construction to identify any areas of concern and also video the building and property upon completion. The property at the end of construction shall be in the same condition as the start of the project. Any necessary repairs will be the responsibility of the GC.
43. GC is responsible for safe pedestrian access along the property. GC maintains public sidewalk and neighbor access along N. Congress / N. Chancellor for the full duration.
44. Gc shall provide and coordinate all required Fire Watch Services for the Project, including Fire Watch required for hot work operations and fire protection system impairments, regardless of which Prime Contractor performs the Work necessitating the Fire Watch.
45. GC is responsible for all finishes indicated on the Architectural drawings, including but not limited to ceilings, walls, and any other finish type work.
46. GC shall be responsible for all sprinkler head penetrations that relate to new Fire Protection drawings. PC/FPC shall verify all locations prior to install
47. PC/FPC is responsible for the Fire Protection. The GC shall be responsible for coordinating with the scope of the PC/FPC as needed.

1.11 Temporary facilities and controls in the General Construction Contract include, but are not limited to, the following:

a. Winter Conditions. The schedule for this work must be maintained. The GC is responsible for snow and ice removal of all areas designated for construction.
b. GC is responsible to maintain lawn areas within the construction area.
c. GC is responsible for pest control within the construction area.
d. GC shall provide and pay for Temporary Heating, Ventilation and Cooling, and fuel, until Substantial Completion.
e. GC is responsible for all water needs on Project using water trucks until new water service is available at the building.
f. Refer to Section 01 5000 Temporary Facilities and Controls, for additional requirements.

1.12 HVAC CONTRACT (MC/HVAC)

A. The Work under the HVAC Construction Contract includes, but is not limited to, the following:

1. All Work as specified in the contract documents.
2. HVAC Systems and Equipment as shown and specified.
3. HVAC instrumentation and controls.
4. Starting, Commissioning, adjusting, and training of all HVAC equipment
5. All exhaust air systems.
6. Mechanical connections to equipment furnished by other contracts.
7. HVAC condensate drain pumps and related electrical connections and wiring.
8. Integrate site-lighting control points into the building DDC as shown on the Division 23 points list.
9. Final low voltage wiring and electrical connections to all heating, ventilating and air conditioning equipment as required.
10. Roof cutting and patching by GC.
11. Selective demolition of all HVAC per plans.
12. Preparation of ductwork and HVAC/Electrical coordination drawings.
13. Firestopping of HVAC work.
14. All existing and new duct work must be professionally cleaned prior to turnover of the system to the Owner.
15. MC shall be responsible for the disassembling and reassembling of any equipment related to their scope of work that does not fit in the accessible routes (Doors, Stairs to Attic Area)

16. MC shall be responsible for coordinating with the Council Rock School District, Construction Manager, and Architect on the requirements of having any reassembled equipment and following the UL Certification Guidelines.
17. MC shall implement the certification schedules into the Project Schedule to prevent long lead times and any delays with startup dates.
18. PC/FPC is responsible for the Fire Protection. The MC shall be responsible for coordinating with the scope of the PC/FPC as needed.

1.13 Temporary facilities and controls in the Mechanical Construction Contract include, but are not limited to, the following:

a. New filter changes at substantial completion.

1.14 PLUMBING / FIRE PROTECTION CONTRACT (PC/FPC)

A. Plumbing and Fire Protection Work are combined into a single Contract for this project.

B. Work in the Plumbing/Fire Protection Contract includes, but is not limited to, the following:

1. All work as shown on the Plumbing and Fire Protection drawings.
2. Storm sewer and water service in the building, and up to five (5) feet outside of the building.
3. Domestic water distribution including main water service systems.
4. Plumbing fixtures including domestic water heater, combustion air, and vent.
5. Sanitary waste.. Sanitary waste and vent are included; under-slab work occurs while the ground-floor slab is open. PC shall own the building sanitary / vent / building storm to 5 feet outside of the foundation walls, including under-slab reroutes while the ground floor is open. Video and clean at turnover. Gutters, downspouts, boots and the pipe should be by the GC. All are within 5’ of the building.
6. Natural gas piping. PC responsibilities for gas service shall be as stated on the Drawings.
7. All natural gas piping work required for boilers.
8. All natural gas piping work required for generator.
9. Radon piping as indicated on the Drawings.
10. Condensate piping.
11. Stormwater drainage to five (5) feet outside building.
12. Plumbing connections to equipment furnished by the General Construction Contract, Plumbing/Fire Protection Contract, HVAC Contract, and Electrical Contract.
13. Preparing plumbing drawings and assisting HVAC Contractor in preparation of coordination drawings.
14. Coordinate work with all contractors including, but not limited to electrical, general and HVAC contractors. Coordinate and confirm locations and rough-in for all work with all contractors. Make location adjustments as required.
15. Firestopping of Plumbing/Fire Protection Contractor Work.
16. Provide temporary water service for construction per Temporary Facilities, including but not limited to hose bibs and meter. Refer to Section 01 50 00 “Temporary Facilities and Controls”, Article 3.3.C, for Plumbing Contractor’s scope after new water service is available at the building.
17. Coordinate with the EC on wiring and connections for new and existing as needed.
18. Selective demolition of all plumbing fixtures as shown in the plans.
19. All Plumbing fixtures as shown on the plans.
20. Domestic water distribution modifications as indicated on the plans.
21. Sanitary re-routing, waste, and vents as shown on the plans.
22. Special Plumbing systems including the following:

    a. Natural gas distribution from the main to the Generator.
    b. Natural gas distribution revisions as shown on the plans.

23. Plumbing connections to equipment furnished by other contracts.
24. Low voltage final electrical connections to all plumbing contracts supplied electrically powered equipment.

25. Existing and new sanitary lines must be cleaned and videoed professionally prior to turnover of the system to the Owner.
26. Responsible for cutting, capping and or removing any existing lines (Copper, Steel, Aluminum Etc.) that are abandoned that interfere with any new construction and/or new equipment being installed.
27. Coordinate with all trades and to include the Owner and Construction Manager as needed.
28. Temporary facilities and controls in the Plumbing Construction Contract include, but are not limited to, the following:
    a. Piped Sewerage and Drainage.
    b. Piped Gas service.
    c. Piped Water service.
    d. Plumbing connections to existing systems and temporary facilities and controls furnished by other contractors.
    e. Temporary water during construction.

29. Preparing of sprinkler drawings and assisting HVAC Contractor in preparation of coordination drawings.
30. Fire suppression sprinklers including pumps, sprinkler piping, heads, flow and tamper switches, corrosion mitigation system, trim, accessories, and support.
31. Fire suppression hydraulic calculations to size fire suppression system.
32. Perform all required Fire Protection system flushes and fills at the completion of each Phase.
33. Fire suppression sprinklers including pumps, sprinkler piping, heads, flow and tamper switches, corrosion mitigation system, trim, accessories, and support.
34. PC/FPC shall coordinate with the GC on all penetrations for new and existing sprinkler heads.

1.15 ELECTRICAL CONTRACT (EC)

A. Work in the Electrical Contract includes, but is not limited to, the following:

1. Site excavation required for electrical systems.
2. Site electrical distribution.
3. Site lighting including site pole concrete footing and bases, light poles, and light fixtures.
4. Site conduits, ducts, handholes for lighting, power communications and security.
5. Electrical distribution.
6. Electrical grounding.
7. Lighting and power branch wiring.
8. Special electrical systems, including the following:
    a. Owner-Furnished Contractor-Installed Packaged engine generator systems, including automatic transfer switches and temporary generator connection equipment, and associated accessories. EC shall receive, store, install, connect, startup coordinate, and support testing.
    b. Public address and intercom systems, including speakers, amplifiers, distribution, handsets, etc.
9. Electrical connections to equipment furnished under other contracts.
10. Structural supports, hangers, sleeves and inserts for new electrical systems and components.
11. New sleeves through existing exterior walls for all electrical components.
12. Luminaires, lighting controls and all accessories.
13. Fire detection and notification systems, including but not limited to smoke detectors, carbon monoxide detectors and strobes.
14. Conduits and raceway for special systems as required.
15. Emergency lighting systems and exit signs.
16. Coordinate work with all contractors including, but not limited to plumbing, general and HVAC contractors. Coordinate and confirm locations and rough-in for all work with all contractors. Make location adjustments as required.
17. Cable tray for all work as specified.
18. Raceways for all work.
19. Spare site underground conduits.
20. All rough-in including conduit, pull wire in conduit, and back boxes for all work.
21. Floor and wall boxes for all work.

22. Wiring, terminations, accessories for complete CCTV system (conduit and Cat 6 cable).
23. Furnish and install all accessories, hangers, Velcro wraps, etc.
24. Provide electrical dimensions and drawings and assist HVAC Contractor in preparation of coordination drawings.
25. Firestopping of Electrical Contractor Work.
26. Furnish and install racks, patch panels, cross connect, and punch blocks.
27. Furnish and install wall jacks and face plates.
28. Provide equipment and all necessary wiring for interfacing of the following systems:

    a. HVAC equipment
    b. Temperature control
    c. Plumbing equipment

29. EC provides construction power and OSHA temp lighting for all phases of the project, and keeps a continuous path to the PECO service so startup and commissioning are not waiting on a shutdown.. Also see Section 015000 “Temporary Facilities and Controls” for temporary power needs.
30. Coordinate utility transformer installation and all primary and secondary cable terminations with local utility.
31. Provide coordination, furnish and install conduit, duct bank vaults, etc. for all power coming onto the site and all underground power to new transformer and electrical switchgear as shown on drawings and in compliance with PECO requirements.
32. Coordinate work with all of the Owner’s vendors and sub-contractors including, but not limited to Telecom, Security, and Audio Visual. Coordinate and confirm locations and rough-in for all work with all vendors and sub-contractors. Make location adjustments as required.
33. All work as shown on the Electrical drawings.
34. Selective demolition in portion of existing building to be altered.
35. Site electrical distribution including all site trenching for electrical Work, conduit installations, backfilling, and compaction.
36. Site lighting and building lighting.
37. Site communications and security.
38. Electrical service and distribution.
39. Special Electrical systems, including all conduit and pull strings for data connections.
40. High Voltage Electrical connections to equipment furnished by other contracts.
41. Receive, coordinate, install and connect Owner supplied items, including but not limited to Generator, ATS.
42. Coordinate final connections and load bank test with Owner’s vendor.
43. Coordinate electrical service to the building with PECO. All work necessary to gain service to the building will be the responsibility of the EC.
44. Coordinate with Owner’s Vendor on access control and security cameras. Owner’s Vendor will provide equipment, programming, recording equipment, POE switches and mounts for access control and CCTV systems. EC shall wire and install all devices.
45. Coordinate with Owner’s Vendor on all required work related to Owner’s Vendor’s audio and video installation. Refer to Owner’s Vendor’s plans and Design Professionals’ plans for scope of work. Electrical Contractor (EC) is responsible for all coordination with Owner’s Vendor.
46. EC to coordinate with PC/FPC on Fire Protection. EC shall be responsible for reconnection to any boxes, wire pulls as needed.
47. PC/FPC is responsible for the Fire Protection. The EC shall be responsible for coordinating with the scope of the PC/FPC as needed.
48. The EC is responsible for installing all equipment pertaining to their scope, it is the EC’s responsibility for all means and methods of deliverables and to coordinate with the Manufacturer and Owner on mobilizing, disassembling, and reinstalling all equipment as needed. The EC shall be responsible for transporting all electrical equipment stored by Owner to the site and assemble as needed.
49. EC shall be responsible for coordinating with Council Rock School District, the Construction Manager, and the Electrical Design Professional on the requirements of having any reassembled equipment and following the UL Certification Guidelines.EC shall implement the certification schedules into the Project Schedule to prevent long lead times and any delays with startup dates.

1.16 Temporary facilities and controls in the Electrical Construction Contract include, but are not limited to, the following:

    a. Electric power service and distribution as necessary for construction.

b. Lighting and temporary lighting that meets OSHA requirements and temporary lighting as required for drywall installation. Existing fixtures may be used for temporary lighting as long as they are secured and properly removed post construction.

1.17 OWNER-FURNISHED PRODUCTS

A. Owner will furnish products indicated. The Work includes providing support systems to receive Owner's equipment and making plumbing, mechanical, and electrical connections. Owner furnished products also includes existing items to be relocated by the Contractor (OFCR).

1. Owner will arrange for and deliver Shop Drawings, Product Data, and Samples to Contractor.
2. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule.
3. After delivery, Owner will inspect delivered items for damage. Contractor shall be present for and assist in Owner's inspection.
4. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.
5. Owner will arrange for manufacturer's field services and for delivery of manufacturer's warranties to Contractor.
6. Owner will furnish Contractor the earliest possible delivery date for Owner-furnished products. Using Owner-furnished earliest possible delivery dates, Contractor shall designate delivery dates of Owner-furnished items in Contractor's Construction Schedule.
7. Contractor shall review Shop Drawings, Product Data, and Samples and return them to Architect noting discrepancies or anticipated problems in use of product.
8. Contractor is responsible for receiving, unloading, and handling Owner-furnished items at Project site.
9. Contractor is responsible for protecting Owner-furnished items from damage during storage and handling, including damage from exposure to the elements.
10. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.
11. Contractor shall install and otherwise incorporate Owner-furnished items into the Work.

B. Owner-Furnished, Contractor Installed Products; (OFCI):

1. Residential Appliances, including full size refrigerator and undercounter refrigerator indicated in Drawing Sheet A8.7, unless noted otherwise on the drawings.
2. CCTV Camera System.
3. Building Security System.
4. Building Access Control System.
5. Furniture.
6. Wall mounted framed art and photos, and wall-mounted plaques.
7. Video monitors.
8. Projection screens
9. Ceiling-mounted projectors
10. Generator and ATS.
11. Toilet Room Accessories: Including but not limited to - paper, paper towel, and soap dispensers in all toilet rooms and in other areas as noted.
12. Other items as noted on the drawings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 12 50

SECTION 01 21 00 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements governing allowances.

1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.

B. Types of allowances include the following:

1. Lump-sum allowances.
2. Owner Contingency allowances.

C. Related Sections include the following:

1. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders for allowances.
2. Division 1 Section "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.
3. Divisions 2 through 33 Sections for items of Work covered by allowances.

1.3 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Architect/CM of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.

B. At Architect's/CM's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Architect/CM from the designated supplier.

1.4 SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.5 COORDINATION

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.6 LUMP-SUM ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner under allowance and shall include taxes, freight, and delivery to Project site.

B. Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner under allowance shall be included as part of the Contract Sum and not part of the allowance.

1.7 OWNER CONTINGENCY ALLOWANCES

A. Use the contingency allowance only as directed by Architect/CM for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.

B. Contractor's overhead and profit and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.

C. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

PART 2 – EXECUTION

2.1 LIST OF ALLOWANCES

A. Refer to those indicated on the individual bid forms

END OF SECTION 01 21 00

SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for unit prices.

B. Related Sections include the following:

1. Division 1 Section "Allowances" for procedures for using unit prices to adjust quantity allowances.
2. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
3. Division 1 Section "Quality Requirements" for general testing and inspecting requirements.

1.3 DEFINITIONS

A. Unit price is an amount stated on the bid form by the Contractor as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. List of Unit Prices: Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 LIST OF UNIT PRICES

A. Refer to those indicated on the individual bid forms

END OF SECTION 01 22 00

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other work of the Contract.

C. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Refer to those indicated on the individual bid forms

END OF SECTION 01 23 00

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. .
2. Section 01 21 00 "Allowances" for products selected under an allowance.
3. Section 01 23 00 "Alternates" for products selected under an alternate.
4. Section 01 25 00.1 “Substitution Request Form”.
5. Section 01 60 00 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use form provided in Project Manual.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.

h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Substitution request is fully documented and properly submitted.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals of authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.

h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

2. The Owner will not accept mechanical substitutions after the bid opening date.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

SECTION 01 25 00.1 - SUBSTITUTION REQUEST FORM

A. Submissions for approved substitutions will be permitted and processed in accord with Article 10 of Specification Section 001100 “Instructions to Bidders”.

B. Submissions will be "received dated" immediately upon arrival at the office of the Architect.

C. All Submissions must be received ten (10) days prior to bid or they may not be reviewed.

D. Reviewer's General Criteria for review will be:

1. Burden of proof of performance equality and completeness of this submittal is the responsibility of the submitter.
2. Reviewers will not be required to complete the submittal, that is, select from options or between models and lines of products.
3. Reviewer will not be required to seek information from the manufacturer's literature on file in the office, or information from other locations.
4. Product must be equal, or better, in those features and performance which specified product provides.
5. When in the reviewer's opinion, significant deficiencies are established, further review of submitted data is not required.

E. Reviewer will note action (approval or disapproval), the date, and their initials.

F. If a submittal is disapproved, reviewer will make notations that will be adequate to guide a later reviewer to the same conclusion. Sample notations may be: "Submittal vague", "incomplete", or "product equality not substantiated".

G. Submittals received after closing time will be "received dated," marked "late", initialed, and filed without review.

H. Submittals will be filed in the project file until completion of the project, then destroyed.

I. Approval of a substitute item will be communicated to bidders in the form of an Addendum.

TO:

Marotta / Main Architects
214 North Duke Street
Lancaster, PA 17602

Boyle Construction Inc.
3850 Sierra Circle, Suite 400
Center Valley, PA 18034

PROJECT _____

PRIME BIDDER _____

CONTRACTOR/SUPPLIER _____

We hereby submit for consideration the following product instead of specified item for above project:

SECTION/DRAWING	PARAGRAPH/DETAIL	SPECIFIED ITEM
_____	_____	_____

Proposed Substitution: _____

MANUFACTURERS HOME OFFICE:	LOCAL REPRESENTATIVE:
Address: _____	Address: _____
Telephone: _____	Telephone: _____
Contact: _____	Contact: _____

Attached to this request is product data, specifications, performance tests and data, and color samples. The attached information also includes any modifications of the Contract Documents which would be required if this substitution is utilized for this Project.

The undersigned states that as a Prime Bidder on the above referenced Project the following statements are true.

1. The Prime Bidder has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.
2. That the product manufacturer will provide the same warranty for the Substitution as for the specified Product.
3. That the use of this product will not have an adverse effect on any other trade or Prime Contractor or the Construction Schedule.
4. That the use of this product does not affect the dimensions shown on the Drawings unless specifically stated in the attached information.

Reason for Substitution:

_____

_____

_____

ATTACHMENTS *(If not applicable, write N/A in space provided)*

No. 1 Complete product data, including technical data and laboratory tests, if applicable.

_____

No. 2 Drawings indicating dimensional changes. _____

No. 3 Complete description of changes to drawings and specifications which proposed substitution will require for its proper installation.

_____

No. 4 Necessary samples and substantiating data to prove equal quality, performance, and appearance to that which is specified. Clearly mark manufacturer's literature to indicate equality in performance. Differences in quality of materials and construction shall be indicated.

No. 5 List of names and addresses of three similar projects on which product was used, date of installation, and Architect/Engineer's name, address, and telephone numbers.

_____

_____

_____

Fill in blanks below *(Provide attachments if more space is necessary)*

A. Does the substitution affect dimensions indicated on the Contract Drawings?

Yes _____ No _____ If yes, clearly indicate changes:

_____

B. Will the undersigned pay for changes to the building design, including engineering and detailing costs caused by the requested substitution?

_____

_____

C. What effect does substitution have on other trades, other contracts, and Contract Completion Date?

_____

D. What effect does substitution have on applicable code requirements?

_____

E. List differences between proposed substitution and specified item

_____

_____

_____

_____

F. Identify manufacturer's guarantees: _____

_____

G. Identify cost impact; Provide attachments showing proposed credit:

_____

_____

Undersigned attests function and quality equivalent or superior to specified item.

CERTIFICATION OF EQUAL PERFORMANCE:

Submitted by: _____ Title: _____

Company: _____

Address: _____

Date: _____

Telephone: _____ E-mail: _____

Signature: _____

. . . . . .

For Use by the Architect/Engineer:

Accepted: _____ Accepted as Noted: _____

Not Accepted: _____ Received Too Late: _____

Reviewer: _____ Date: _____

REMARKS: _____

_____

_____

END OF SECTION 01 25 00.1

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1. Multi Prime Contracts:

General/Site (GC/SC)
Plumbing/Fire Protection (PC/FP)
Mechanical (MC)
Electrical (EC)
Abatement (AC)

B. Related Sections: The following Sections contain requirements that relate to this Section.

1. Division 01 Section "Submittals" for requirements for the Prime Contractors.
2. Division 00 Section "Procurement Substitution" for administrative procedures for handling requests for substitutions made after award of the Contract.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 CHANGE ORDER PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within twenty (20) days, when not otherwise specified after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change to the Architect for the Owner's review.

   a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
   b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
   c. Include costs of labor and supervision directly attributable to the change.

d. Include an updated Prime Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Prime Contractor may initiate a claim by submitting a request for a change to Construction Manager/Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Comply with requirements in Section 00 "Procurement Substitution" if the proposed change requires substitution of one product or system for product or system specified.
5. Proposal Request Form: Use AIA Document G709 for Change Order Proposal Requests.

1.5 ALLOWANCES

A. Allowance Adjustment: For allowance-cost adjustment, base each Change Order Proposal on the difference between the actual purchase amount and the allowance, multiplied by the final measurement of work-in-place. Where applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.

1. Include installation costs in the purchase amount only where indicated as part of the allowance.
2. When requested, prepare explanations and documentation to substantiate the margins claimed.
3. Submit substantiation of a change in scope of work claimed in the Change Orders related to unit-cost allowances.
4. The Owner reserves the right to establish the actual quantity of work-in-place by independent quantity survey, measure, or count.
5. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or the Prime Contractor's handling, labor, installation, overhead, and profit. Submit claims within 21 days of receipt of the Change Order or Construction Change Directive authorizing work to proceed. The Owner will reject claims submitted later than 21 days.
   a. Do not include the Prime Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in Contract Documents.
   b. No change to the Prime Contractor's indirect expense is permitted for selection of higher or lower-priced materials or systems of the same scope and nature as originally indicated.

B. Unit Price Adjustment: Refer to Division 01 Section “Unit Prices” for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit price work.

1.6 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, Construction Manager/Architect will issue a Change Order for signatures of Owner and Prime Contractor on AIA Document G731.

1.7 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: When the Owner and Prime Contractor disagree on terms of a Proposal Request, the Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Prime Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

SECTION 01 29 00 - APPLICATION FOR PAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

1. Coordinate the Schedule of Values and Applications for Payment with the Prime Contractor's Construction Schedule, Submittal Schedule, and List of Subcontracts.

B. Related Sections: The following Sections contain requirements that relate to this Section.

1. Schedules: The Prime Contractor's Construction Schedule and Submittal Schedule are specified in Division 01 Section "Submittals."

1.3 SCHEDULE OF VALUES

A. Coordination: Each Prime Contractor shall coordinate preparation of its Schedule of Values for its part of the Work with preparation of the Prime Contractors' Construction Schedule.

1. Correlate line items in the schedule of values with other required administrative forms and schedules, including the following:

   a. Prime Contractor’s Construction Schedule.
   b. Application for Payment forms, including Continuation Sheets.
   c. List of subcontractors.
   d. Schedule of allowances.
   e. Schedule of alternates.
   f. List of products.
   g. List of principal suppliers and fabricators.

2. Submit the schedule of values to Construction Manager 48 hours after the requested by the Construction Manager.
3. Sub-schedules for Phased Work: Where the Work is separated into phases requiring separately phased payments; provide sub-schedules showing values correlated with each phase of payment.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:

   a. Project name and location.
   b. Name and Phone Number of Construction Manager
   c. Name and Phone Number of Architect’s
   d. Prime Contractor's name and address.
   e. Date of submittal.

2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:

    a. Related Specification Section or Division.
    b. Description of Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change Orders (numbers) that affect value.
    g. Dollar value.

        1) Percentage of Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Break principal subcontract amounts down into several line items.

4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.

5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment, purchased or fabricated and stored, but not yet installed.

    a. Differentiate between items stored on-site and items stored off-site. Include requirements for insurance and bonded warehousing, if required.

6. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

7. Unit-Cost Allowances: Provide a separate line item in the schedule of values for Allowances. Show as one line item.

8. Margins of Cost: Show line items for indirect costs and margins on actual costs only when such items are listed individually in Applications for Payment. Each item in the Schedule of Values and Applications for Payment shall be complete. Include the total cost and proportionate share of general overhead and profit margin for each item.

    a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at the Prime Contractor's option.

9. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum

1.4 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

    1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: See AIA Document A101 for Application for Payment submittal schedule.

C. Application for Payment Forms: Use AIA Document G732 and AIA Document G703 as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Prime Contractor. Incomplete applications without action.

1. Entries shall match data on the schedule of values and Prime Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Submit signed and notarized original copies of each Application for Payment via Procore Invoicing Tool. This shall include waivers of claims and similar attachments when required.

F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. List of principal suppliers and fabricators.
3. Schedule of Values.
4. Approved Prime Contractor's Construction Schedule.
5. Schedule of principal products.
6. Schedule of unit prices.
7. Submittal Schedule (preliminary if not final).
8. List of Prime Contractor's staff assignments.
9. List of Prime Contractor's principal consultants.
10. Copies of building permits.
11. Copies of authorizations and licenses from governing authorities for performance of the Work.
12. Initial progress report.
13. Report of preconstruction meeting.
14. Certificates of insurance and insurance policies.
15. Performance and payment bonds.
16. Data needed to acquire the Owner's insurance.
17. Initial settlement survey and damage report, if required.
18. Weekly Payroll Certificates for Public Works Projects, 1st submittal to be notarized.

H. Application for Payment at Substantial Completion: Following Issuance of the Certificate of Substantial Completion, Submit an Application for Payment.

1. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
2. Administrative actions and submittals that shall precede or coincide with this application include: Occupancy permits and similar approvals.
   a. Warranties (guarantees) and maintenance agreements.
   b. Test/adjust/balance records.
   c. Maintenance instructions.
   d. Meter readings.
   e. Startup performance reports.
   f. Changeover information related to Owner's occupancy, use, operation, and maintenance.
   g. Final cleaning.
   h. Application for reduction of retainage and consent of surety.
   i. Advice on shifting insurance coverages.
   j. Final progress photographs.
   k. List of incomplete Work, recognized as exceptions to Architect's Certificate of Substantial Completion.

I. Final Payment Application: Administrative actions and submittals that must precede or coincide with submittal of the final Application for Payment include the following: Completion of Project closeout requirements.
1. Completion of items specified for completion after Substantial Completion.

2. Ensure that unsettled claims will be settled.
3. Ensure that incomplete Work is not accepted and will be completed without undue delay.
4. Transmittal of required Project construction records to the Architect and Owner.
5. Certified property survey.
6. Proof that taxes, fees, and similar obligations were paid.
7. Removal of temporary facilities and services.
8. Removal of surplus materials, rubbish, and similar elements.
9. Change of door locks to Owner's access.
10. Weekly payroll certificates for public works projects, final payment to be notarized.
11. Any other itinerary established by the Architect and/or Owner.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

SECTION 01 3100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General project coordination procedures
2. Submittals.
3. Administrative and supervisory personnel.
4. Project meetings.
5. Web based project management system.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.

C. Related Sections include the following:

1. Section 011250 "Multiple Contract Summary" for a description of the division of work among separate contracts and responsibility for coordination activities not in this Section.
2. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
3. Division 01 Section 017123 “Field Engineering” for procedures for field-engineering services, including establishment of benchmarks and control points.
4. Division 01 Section 017700 "Closeout Procedures" for coordinating Contract closeout.
5. Section 019113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.3 COORDINATION

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. If necessary, Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work

is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Pre-installation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.
9. Project closeout activities.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Owner's property.

E. Each Contractor shall:
1. Perform his Work as mandated by the project schedule to maintain the required sequence and the overall progress of the project.
2. Coordinate Work of his own employees and subcontractors.
3. Expedite his Work to assure compliance with approved schedules.
4. Coordinate his Work with that of other Prime Contractors and work by the Owner.

F. Modifications to the Work made necessary by a Contractor’s failure to properly coordinate the Work, shall be made by that Contractor, at no cost to the Owner.

G. Remove Work installed out of sequence that prohibits a separate Prime Contractor the ability to install Work that is dependent on their prior installation of materials or equipment. No additional compensation or time extension will be considered for the uncovering or removal of the out of sequence Work.

H. Each Prime Contractor shall coordinate space requirements and installation of mechanical and electrical work indicated diagrammatically on the Contract Drawings. Follow routing shown for pipes, ducts and conduit as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance and for repairs.

I. Where availability of space is limited, the Construction Manager and each Prime Contractor shall coordinate installation of different components with other Prime Contractors to assure maximum accessibility for required maintenance, service and repair and to meet governing code requirements.

J. Each Prime Contractor shall make adequate provisions to accommodate items scheduled for later installation.

K. Each Prime Contractor shall, in finished areas except as otherwise indicated, conceal pipes, ducts and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements provided by other Contractors.

L. Each Prime Contractor shall verify utility requirement characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

M. Each Prime Contractor shall coordinate Testing and Inspection Services:

1. Verify required laboratory personnel are present.
2. Verify tests are made in accord with specified standards.
3. Review test reports for compliance with specified standards.
4. Recommend and administer any required retesting.
5. Submit copies to the Owner, Architect/Engineer, and Construction Manager.
6. Coordinate with Owner's Geotechnical Engineer for compaction and moisture content testing. Notify Geotechnical Engineer in advance of need for testing in accord with Project Construction Schedule.
7. Coordinate with Owner's Inspection Agency for concrete, masonry and steel testing and inspection. Notify agency in advance when testing and inspection is required.

N. Each Prime Contractor shall coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion, and for portions of Work designated for Owner's partial occupancy.

O. Each Prime Contractor shall, after Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accord with Contract Documents, to minimize disruption of Owner's activities.

1.4 SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:

   a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
   b. Indicate required installation sequences.
   c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect/CM for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

2. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

B. Key Personnel Names: Within 7 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.
2. Provide list to Owner, Architect, and Construction Manager.

1.5 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

1. Include special personnel required for coordination of operations with other contractors.

1.6 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise

indicated.

1. Attendees: Authorized representatives of Owner, Architect and their consultants; Prime Contractor(s) and their superintendent; major subcontractors and other Owner pre-approved parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Tentative construction schedule.
    b. Phasing.
    c. Critical work sequencing.
    d. Designation of responsible personnel.
    e. Procedures for processing field decisions and Change Orders.
    f. Procedures for processing Applications for Payment.
    g. Distribution of the Contract Documents.
    h. Submittal procedures.
    i. Preparation of Record Documents.
    j. Use of the premises.
    k. Responsibility for temporary facilities and controls.
    l. Parking availability.
    m. Office, work, and storage areas.
    n. Equipment deliveries and priorities.
    o. First aid.
    p. Security.
    q. Progress cleaning.
    r. Working hours.
    s. Construction Waste Management Plan activities.
    t. Construction IAQ Management Plan activities.

B. Pre-installation Conferences: Conduct a pre-installation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect and Construction Manager of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

    a. The Contract Documents.
    b. Options.
    c. Related requests for interpretations (RFIs).
    d. Related Change Orders.
    e. Purchases.
    f. Deliveries.
    g. Submittals.
    h. Review of mockups.
    i. Possible conflicts.
    j. Compatibility problems.
    k. Time schedules.
    l. Weather limitations.
    m. Manufacturer's written recommendations.
    n. Warranty requirements.
    o. Compatibility of materials.
    p. Acceptability of substrates.
    q. Temporary facilities and controls.
    r. Space and access limitations.

s. Regulations of authorities having jurisdiction.
t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

C. Progress Meetings: Conduct progress meetings at weekly intervals. Coordinate dates of meetings with preparation of payment requests.

1. Attendees: In addition to representatives of Owner, Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1. Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1. Interface requirements.
2. Sequence of operations.
3. Status of submittals.
4. Deliveries.
5. Off-site fabrication.
6. Access.
7. Site utilization.
8. Temporary facilities and controls.
9. Work hours.
10. Hazards and risks.
11. Progress cleaning.
12. Quality and work standards.
13. Status of correction of deficient items.
14. Field observations.
15. Requests for interpretations (RFIs).
16. Status of proposal requests.
17. Pending changes.
18. Status of Change Orders.

19. Pending claims and disputes.
20. Documentation of information for payment requests.

3. Reporting: The Construction Manager will distribute minutes of the meeting to each party present and to parties who should have been present. Minutes will include a brief summary, in narrative form, of progress since the previous meeting and report.

   a. The Contractor shall revise the Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting. Contractor shall provide and include a two- week look ahead schedule.

D. Weekly Superintendent Meetings: Attend weekly superintendent meetings scheduled and chaired by the General Contractor.

1. Attendees: In addition to representatives of the Owner and Construction Manager, each contractor and subcontractor responsible for work in the upcoming two weeks to be represented.
2. Agenda: Review the work planned in the next two weeks and other items that may affect work in the short-term including:

   a. Deliveries.
   b. Site traffic patterns.
   c. Subcontractors working at the site.
   d. Maintenance of erosion and sediment control features.
   e. Site cleanliness.
   f. Planned work hours.
   g. Coordination items .

3. At each coordination meeting, the following shall occur:

   a. GC shall provide a two-week look ahead schedule from the current overall CPM schedule listing the tasks start, finish, and total float for the next two weeks.
   b. Each prime contractor superintendent shall be prepared to address the two-week list of tasks and provide their plan for executing each task as per the schedule.
   c. If any task is not going to be met, contractors shall then provide immediate recovery plan which will be incorporated into the overall schedule update.

4. At each coordination meeting, each Prime Contractor is to provide a written two-week look ahead schedule to the General Contractor and Construction Manager for review and comment.
5. The General Contractor shall write meeting minutes for each coordination meeting and distribute them to each Prime Contractor and to the Construction Manager for review within two days after the meeting.

1.7 WEB BASED PROJECT MANAGEMENT

A. Refer to Section 013125 – Web Based Project Management System.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

SECTION 01 31 25 – WEB-BASED PROJECT MANAGEMENT SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section contains general information that applies to all work performed under the Contract Documents.

B. Prime Contractors shall use Internet/Web-based project management software to transmit documents, track, and otherwise manage this project.

C. Use of this project management software will not change any contractual responsibilities of the construction team members.

D. Related Sections include the following:

1. Division 01 Section 013300 “Submittal Procedures”.
2. Division 01 Section 012900 “Application for Payment”.

1.3 DEFINITIONS

A. System: A real time Web-based software that shares data, translates data, organizes data, facilitates communication, archives actions, and offers scheduling prompts to identified Users.

B. Users: Participants of this project will be invited to Procore and will each create their own password to access the system to view/upload/download data. Owner, Construction Manager, Architect, Engineers and the Prime Contractors are all Users. Other Users may be added as necessary.

C. Contacts: Entities identified to automatically receive specific transmissions or entities selected to receive specific information sent by the system through to an e-mail address.

1.4 USE OF SYSTEM

A. The use of the Construction Manager’s Web-based system is mandatory for the documentation of the transmittal of all non-oral information, even if the actual transmission of the information is by another means.

B. The use of the system will be mandatory by the Prime Contractors to send, retrieve, and respond to data.

C. Where written notification is required by the Contract Documents, an unofficial notification may be sent via the Web-based project management system, but the notification will not be considered received and the timelines will not commence until a paper copy with written signature is received as described in the Conditions of the Contract.

D. Electronic drawings for the project on Procore will be managed by the CM and available for discussion and information in the field office.

1.5 QUALITY ASSURANCE

A. One (1) two-hour training session in the use of the software for this project will be offered by the Construction Manager at a location convenient to the project site. Attendance by one member of each Prime Contractor's organization is mandatory. Each Prime Contractor may enroll up to four (4) additional attendees. All attendees must have a working knowledge of computers and Windows Explorer.

B. Technical assistance will be provided by telephone for all licensed Users throughout the life of the project by the Construction Manager. A total of two (2) hours per contractor will be provided free of charge dispensed in 15-minute intervals.

1.6 SUBMITTALS

A. Submit to the Construction Manager, within 10 days following the Intent to Award, in an electronic template furnished by the Construction Manager, the following:

1. Name of organization.
2. Names, mailing addresses, electronic addresses, telephone numbers, and fax numbers of its Users and Contacts, up to a maximum of two (2) users.
3. Designation of each User into a communication category.

1.7 SOFTWARE AND HARDWARE REQUIREMENTS

A. Each User shall provide and maintain a compatible workstation. Workstation shall have a 32-bit operating system (Windows 7 higher), a high-speed internet browser and a high-speed cable Internet access, high speed DSL or T1 line, and Adobe Acrobat or similar.

B. In addition to any other locations he may select, the General Contractor is required to provide, at the project site, high speed internet connection for his use and a 128K ISDN line for the Architect's and Construction Manager's use during work hours in the Construction Manager's construction trailer. Cost for these items shall be borne by the General Contractor.

PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION

A. The Web-based project management system is a "secure, real-time, interactive, centralized database" specifically established and maintained for the management of this construction project. The product is designed to facilitate communication and improve the time management of its users by facilitating the sharing of information. Information will be available 24/7, from any computer meeting the specifications listed above. The information is fully protected, backed up daily, and archived. The electronic platform allows information to be transmitted across the Internet reducing printing and postage costs and the time associated with such activities.

B. The system contains a directory of the project participants.

C. The system includes templates, with the User's letterhead, for each document created inside the system. The template allows the use of "pull down" menus to complete significant portions of each document.

D. The system allows the templates (and attached documents created outside the system) to be distributed to Users and Contacts.

E. The System contains "translation software" to permit the viewing (and marking) of documents created outside the system. The system can view documents created by different software programs and can deliver images of its translation to any computer meeting the criteria listed above.

F. The system can be personalized by each User to automatically send e-mail notices upon issuance of certain documents if such a practice facilitates the User's business needs.

G. The system is the product of ***Procore*** (procore.com).

H. The Construction Manager will administer the Procore user account for this Project.

2.2 DOCUMENTS CREATED INSIDE THE SYSTEM

A. The following documents shall be created on templates inside the system.

1. Submittal Log: The Construction Manager will maintain submittal log after it is initialized.
2. Meeting Agenda & Minutes: ("Action Items" may also be tracked by the system).
3. RFI (Requests for Information)
4. RFP (Requests for Proposal)
5. ASI (Architect's Supplemental Instructions)
6. CCD (Construction Change Directives)
7. Daily reports.
8. Project Record Documents.
9. Construction Manager will use it for Daily Report Software.

B. The following documents may, at each Users option, be created on the system.

1. Messages:
2. E-mails: Contacts that do not have access to the system may be sent information from the system, by the system.
3. Reports generated from information on the system.
4. Project Notices: "Broadcast" messages can be sent to other Users system entry screen.
5. Threaded discussions can be created on the system.

C. The Construction Manager will configure the system so all of the above documents are date/time stamped, project specific, and the author(s) identified.

2.3 DOCUMENTS CREATED OUTSIDE THE SYSTEM AND DISTRIBUTED BY THE SYSTEM

A. The following documents are expected to be created outside the system and distributed through the system. The actual documents may be scanned, faxed, or electronically attached to the transmittal.

1. Technical Submittals: Shop drawings, product data, testing reports, certifications, installation instructions, all will be submitted and distributed by the system. The Architect will return all submissions through the system electronically. Contractor(s) may distribute submittals (after Architect's action) electronically, or elect to print paper copies for distribution, or both. **Contractor must keep relevant copies for O&M manuals to be furnished at end of project.**
2. Photographs: Digital photographs, digital video, and scanned film images can be loaded onto the system and shared.
3. Field Notes, pencil sketches, manifests, and similar paper-based data may be scanned or faxed into the data base.
4. AIA documents used on the project may be signed electronically except for the following documents where the record copy requires a "wet" signature on paper.

   a. Schedule of Values/ Payment Applications: (The "pencil" review of these documents will occur inside the system).
   b. Change Orders: (The "pencil" review of these documents can occur inside the system.)
   c. Construction Manager, with acceptance of Owner, may also implement a DocuSign process to expedite all approvals and signatures for Project documents.

5. Schedules: The schedule document(s) will be available for review on the system.

6. Correspondence or Data created in other software may be uploaded to the system electronically.

2.4 DOCUMENTS CREATED OUTSIDE THE SYSTEM AND DISTRIBUTED OUTSIDE THE SYSTEM

A. Product samples, color samples, and those documents listed above requiring a “wet” signature will be distributed outside the system; however, the transmittal documenting the distribution shall be done inside the system and submitted electronically and printed to accompany the actual submission.

B. Color selections will not be made from Web-based management system a color sample is required for color selections.

2.5 ADMINISTRATION OF THE SYSTEM

A. Construction Manager shall regularly review the use of the system and provide direction to correct or increase the ability of the team to collaborate. Users must comply with Construction Manager’s direction. If Construction Manager’s direction is not followed, the Owner will have the right to increase contract retainage until corrections are made.

B. Upkeep of System: The provider of the software platform has been making continuous improvements to its functionality and processing features. These improvements are expected to continue for the life of this project and Users will be required to stay current by means of the information provided on the web site.

C. Storage and Archiving of Data:

1. Users do not have the ability to delete any data in the system.
2. Data is stored, simultaneously in multiple, secure, remote locations.
3. Following final completion of the project, an electronic copy of the User’s data will be made available in a format not dependent on accessing the web site.

D. Username and password are to be used only by the person licensed by the Construction Manager. Any person who does not comply with requirements is subject to a fee equal to the damages that Construction Manager determines is appropriate. Such damages will be deducted from payment application.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 25

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The Work under the Contract Documents shall be planned, scheduled, executed, reported, and accomplished using the cost and resource loaded “Critical Path Method” schedule, in calendar days (excluding Saturdays, Sundays, and legal holidays). The provisions of the General Requirements, Division 01, and the directions of the Project Coordinator (General Contractor) are to be followed by the Contractor in scheduling and coordinating construction activities. The scheduling Services of the Project Coordinator are part of its contract with the Owner, but nothing herein relieves the obligations of each Contractor to schedule their own construction activities, and nothing herein alters the obligation of each Contractor to resolve all supervision, coordination, and scheduling issues between and among the Sub-Contractors. In addition, the requirements for subordinate coordination responsibilities and scheduling per the Division 01 General Requirements must be followed by all contractors.

B. General Scheduling Requirements: Any of the scheduling requirements including, but not limited to, the format, content, and complexity can be waived or modified by the sole discretion of the Construction Manager and Owner only. Any modification or waiver by the Construction Manager shall not be grounds for any claim by Contractor against Owner, Construction Manager, or Architect. Project Coordinator (General Contractor) shall submit preliminary and final construction schedule and all schedule updates in electronic format with no restrictions for viewing and analyzing using the same software with which the schedule was created. Electronic format shall be submitted to the Construction Manager and to any Contractor that Construction Manager may direct.

C. The General Contractor is designated as the Project Coordinator for this Project unless noted otherwise. The Project Coordinator and other Prime Contractors are responsible for coordination of the Work. The Project Coordinator is responsible for making all coordination decisions not mutually agreed to by all affected Prime Contractors. Disputes between or among the Project Coordinator and one or more other Prime Contractors and disputes in connection with the construction schedule, the furnishing of additional resources to meet the project schedule, job coordination, and all aspects of the means and methods of construction shall be submitted promptly to the Project Coordinator for a final construction decision. The Project Coordinator and the affected Prime Contractor or Contractors shall, in connection with all submissions for a final construction decision, provide actual written notice contemporaneously to the Construction Manager. The final construction decision of the Project Coordinator must, at all times, be consistent with content and intent of the Contract Documents and the latest accepted schedule. Should the Owner or Construction Manager determine that, in its sole judgment, substantial interests have been placed at risk by the final construction decision of the Project Coordinator, then the Owner or Construction Manager reserves the right to overrule the final construction decision of the Project Coordinator. The exercise of discretion by the Owner or Construction Manager in this regard shall be unchallengeable, subject only to a determination that the decision constituted an abuse of discretion. In all other instances, the final construction decision of the Project Coordinator will be observed, accepted, and fully followed by all Prime Contractors and their Subcontractors on the project, subject only to the commencement of any litigation between the Prime Contractors. The progress of the Work in accordance with the final construction decision of the Project Coordinator shall not be delayed pending litigation between the Prime Contractors. The damage remedy provided in favor of the Project Coordinator or other Prime Contractor shall be exclusive remedy for disputes between the contractors. The contractors, including the Project Coordinator, shall have no right of action against the Owner, Architect, or Construction Manager in connection with such disputes.

D. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Preliminary Construction Schedule.
2. Contractor's Construction Schedule.
3. Submittals Schedule.
4. Daily construction reports.
5. Material location reports.
6. Field condition reports.
7. Special reports.

E. Related Sections include the following:

1. Division 01 Section 011250 "Multiple Contract Summary" for preparing a combined Contractor's Construction Schedule.
2. Division 01 Section 012900 "Application for Payment" for submitting the Schedule of Values.
3. Division 01 Section 013100 "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
4. Division 01 Section 013300 “Submittal Procedures” for submitting schedules and reports.
5. Division 01 Section 014000 "Quality Requirements" for submitting a schedule of tests and inspections.
6. Division 01 Section 017700 "Closeout Procedures" for submitting photographic negatives as Project Record Documents at Project closeout.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources and include shop drawing preparation, work activities, equipment testing, and training and any other actions required for the prosecution of the work.

1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
2. Predecessor activity is an activity that must be completed before a given activity can be started.
3. Successor activity is an activity that follows another activity in the network.

B. Cost Loading: The allocation of the Schedule of Values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by Architect.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

D. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall Project duration and contains the lowest float valve.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.

1. Float time belongs to Owner and shall only be assigned with Owner’s representative approval.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

H. Major Area: A story of construction, a separate building, or a similar significant construction element.

I. Milestone: A key or critical point in time for reference or measurement.

J. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

K. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 SUBMITTALS

A. Qualification Data: For firms and persons specified in "Quality Assurance" Article and in-house scheduling personnel to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names, and addresses of architects and owners, and other information specified.

B. Submittals Schedule: Submit seven copies of schedule. Arrange the following information in a tabular format:

1. Scheduled date for first submittal.
2. Specification Section number and title.
3. Submittal category (action or informational).
4. Name of subcontractor.
5. Description of the Work covered.
6. Scheduled date for Architect's and all consultants and agencies final release or approval.

C. Preliminary Construction Schedule: Submit seven (7) opaque copies and one (1) electronic copy.

1. Approval of cost-loaded preliminary construction schedule will not constitute approval of Schedule of Values for cost-loaded activities. The electronic copy is to be provided with no restrictions for viewing and analyzing using the same software with which the schedule was created.

D. Preliminary Construction Schedule Network Diagram: Submit seven (7) opaque copies, large enough to show entire network for entire construction period. Show logic ties for activities.

E. Final Construction Schedule: Submit seven (7) printed copies of the initial schedule large enough to show entire schedule for entire construction period. Provide electronic copy if requested.

1. Submit an electronic copy of schedule electronically and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label. The electronic copy is to be provided with no restrictions for viewing and analyzing using the same software with which the schedule was created.

F. Final Construction Schedule Reports: Submit three (3) copies of each of the following computer-generated reports with the Final Construction Schedule. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of all activities sorted by Project Phase, Project Area, Prime Contractor, and then early start date. Provide a duration, cost, and total float value for each activity.
2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.

G. Daily Construction Reports: Submit electronic copies at weekly intervals.

H. Material Location Reports: Submit electronic copies at weekly intervals.

I. Field Condition Reports: Submit electronic copies at time of discovery of differing conditions.

J. Special Reports: Submit two copies at time of unusual event.

1.5 QUALITY ASSURANCE

A. Scheduler's Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Construction Manager's request.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 01 Section 013100 "Project Management and Coordination." Review methods and procedures related to the Preliminary Construction Schedule and Contractor's Construction Schedule including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints including phasing, work stages, area separations, interim milestones, and partial Owner occupancy.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review time required for review of submittals and resubmittals.
7. Review requirements for tests and inspections by independent testing and inspecting agencies.
8. Review time required for completion and startup procedures.
9. Review and finalize list of construction activities to be included in schedule.
10. Review submittal requirements and procedures.
11. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from parties involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.

1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
2. Initial Submittal: Submit concurrently with preliminary schedule. Include submittals required during the first 90 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead-time for manufacture or fabrication.

   a. Show submittals on the Preliminary Construction Schedule, instead of tabulating them separately.

3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Procedures: Comply with procedures contained in Council Rock School District's "Construction Planning & Scheduling."

B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early or late completion date, unless specifically authorized by Change Order.

C. Each activity on the network shall have indicated for it the following:

1. A single duration, no longer than 20 days (i.e., the single best estimate of the expected elapsed time considering the scope of work involved in the activity) expressed in working days. Normal holidays and weather delays shall be included. One critical path shall be shown for the schedule.
2. An activity identification number will be assigned to each activity. The identification number will be in a format acceptable to Project Coordinator.
3. A brief description of the activity will be included. If this description is not definitive, a separate listing of each activity and a descriptive narrative may be required.
4. Each activity shall be cost loaded to indicate the total estimated budget of the activity. No activity budget shall exceed $50,000. Material and/or equipment costs to be paid as stored material shall be listed separately. In addition, activities shall be cost-loaded as requested by Owner's representative for payment purposes.
5. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 40 calendar days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
6. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
7. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Architect and Owner's administrative procedures necessary for certification of Substantial Completion.
8. Each activity (except for procurement activities) shall be man-hour loaded with the estimated man-hours to be expended on each activity.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work under More Than One Contract: Include separate activities for each contract.
3. Work by Owner: Include separate activities for each portion of the Work performed by Owner.
4. Products Ordered in Advance: Include a separate activity for each product.
5. Owner-Furnished Products: Include a separate activity for each product.
6. Work Restrictions: Show the effect of the following items on the schedule:

   a. Coordination with existing construction.
   b. Limitations of continued occupancies.
   c. Uninterruptible services.
   d. Partial occupancy before Substantial Completion.
   e. Use of premises restrictions.
   f. Seasonal variations.
   g. Environmental control.

7. Area Separations: Identify each major area of construction for each Phase of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following phase completion and contract milestone dates listed in the contract documents:
   a. Sitework completion.
   b. Foundation completion.
   c. Structural completion.

d. Permanent space enclosure.
e. Ground Floor.
f. First Floor.
g. Second Floor.
h. Roof.
i. Completion of plumbing/fire protection installation.
j. Completion of mechanical installation.
k. Completion of electrical installation.
l. Substantial Completion.

E. Milestones and Phases: Include milestones and phases indicated in the Contract Documents in schedule including, but not limited to, the Notice to Proceed, Individual Phase Completion(s), Substantial Completion, Final Completion, and the following interim milestones:

1. All project milestones and phases listed in the Contract Documents.

F. Cost Correlations for Progress Payments: Provide cost loading of Preliminary and Final schedule as follows:

1. Each activity on the construction schedule shall be allocated a dollar value in accordance with 2.2.C.4, above. Each activity's assigned cost shall consist of labor, equipment, and materials costs, and a pro rata contribution of overhead and profit. The sum of activities costs shall be equal to the total Contract Price. In submitting cost data Contractor certifies that the costs are not unbalanced and that the value assigned to each activity represents Contractor's estimate of the actual costs of performing that activity.
2. The accepted schedule of values shall represent a fair, reasonable, and equitable dollar cost allocation for each activity on Contractor's construction schedule.
3. If it is determined that the cost data does not meet the requirements for a balanced bid breakdown in the opinion of Owner’s representative, Contractor will present documentation substantiating the cost allocation. Cost allocations shall be considered unbalanced if an activity on the construction schedule has been assigned a disproportionate allocation of direct costs, overhead and profit.

G. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.

H. Computer Software: Prepare schedules using one of the following programs.

1. Primavera P6
2. Microsoft Project
3. Outbuild
4. Procore

2.3 PRELIMINARY CPM CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within thirty (30) calendar days of date established for the Notice of Award.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Provide construction activities for first 90 days of construction. Include costs for each activity.

2.4 FINAL CPM CONSTRUCTION SCHEDULE

A. CPM Schedule: Prepare Contractor's Construction Schedule using a computerized, cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than forty-five (45) calendar days after date established for the Notice to Proceed.

a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.

2. Conduct educational workshops to train and inform key Project personnel, including each contractor’s personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time. Include list of nonworking days and holidays incorporated into the schedule.

B. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a network diagram to identify the critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Within each Phase, include activities and durations for following activities:

a. Preparation and processing of submittals.
b. Mobilization and demobilization.
c. Purchase of materials.
d. Delivery.
e. Fabrication.
f. Utility interruptions.
g. Installation.
h. Work by Owner that may affect or be affected by Contractor's activities.
i. Testing and commissioning.

2. Critical Path Activities: Identify critical path activities, including those for any interim Phase completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

C. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Principal events of activity.
4. Immediately preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Dollar value of activity (coordinated with the Schedule of Values).

D. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports and electronic copies on a monthly basis showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

2.5 FIELD REPORTS

A. Daily Construction Reports: Each contractor shall prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries
6. High and low temperatures and general weather conditions.
7. Accidents.
8. Meetings and significant decisions.
9. An account of work performed on the project.
10. Stoppages, delays, shortages, and unusual events.
11. Meter readings and similar recordings.
12. Site visits or inspections by authorities having jurisdiction.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction or Work Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial Completions and occupancies.
19. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.

C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare a detailed report. Submit a request for information to Architect with copy to Construction Manager on CSI Form 13.2A or other form approved by Architect. Include detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.6 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare, and submit a special report. List chain of events, persons participating, and response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 FIELD REPORTS

A. Contractor is to submit Daily Construction Reports on a daily basis to the Owner’s Representative. Failures to maintain timely or complete reports may result in partial withholding of monthly payment applications.

3.2 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Requirements for the General Contractor as the Project Coordinator. As Project Coordinator, the Contractor for General Construction shall:

1. Engage a scheduling consultant to perform, for and on behalf of the Contractor, the Contractor's duties, and responsibilities as Project Coordinator, including those specifically set forth below. The scheduling consultant shall have a minimum of five (5) years prior experience in the design, preparation, publication, and revision of PCM network schedules, including scheduling experience on multiple prime contracts, multiple phase construction projects. The Contractor shall submit the name, credentials, and experience of its proposed scheduling consultant to the Owner, Architect, and Construction Manager for approval within five (5) days of being awarded the Contract. The Contractor; (a) shall not terminate the engagement of any approved scheduling consultant without at least thirty (30) days prior written notice to the Owner, Architect, and Construction Manager, and then only after submission and approval of a replacement scheduling consultant in accordance with the provisions of this paragraph; and (b) shall not engage any scheduling consultant as to whom the Owner, Architect, and Construction Manager, at any time, make reasonable objection and shall promptly replace such scheduling consultant with another approved in accordance with the provisions of this paragraph.
2. If the Contractor demonstrates to the satisfaction of the Construction Manager that it employs a person with experience and qualifications in the design, preparation, publication, and revision of CPM network schedules, then, upon receipt of written approval from the Owner, the Contractor may assign such employee as the scheduling consultant described herein;
3. Attend and chair meetings at least every two weeks during construction with all separate contractors, the Owner, the Architect, and Construction Manager to review progress and to plan and coordinate the activities of each separate contractor with the Work of the Contractor and of the Owner;
4. Advise the owner, Architect, and Construction Manager of delays or potential delays.
5. Formulate and recommend to the Owner, Architect, and Construction Manager plans, including a revised Project construction schedule, to prevent, minimize, or recover from delays or potential delays.
6. Make recommendations to the Owner, Architect, and Construction Manager concerning whether requests for extensions of time should be granted and the effect such extensions would have on the Project construction schedule.
7. Revise the Project construction schedule to reflect extensions of time granted by the Owner.
8. Resolve objections made by other contractors and make adjustments to the schedule that are mutually agreeable to all prime contractors and the Owner.
9. Prepare monthly schedule updates comparing the actual progress of all Work with the scheduled progress.

B. Scheduling requirements for all Contractors other than the Project Coordinator (General Contractor). All Contractors shall:

1. Within fourteen (14) days after the Notice to Proceed for Construction, prepare and submit to the Project Coordinator and Construction Manager a preliminary construction schedule in a form compatible with the requirements herein. Such construction schedule shall include the Work of the Contractor, show by appropriate notation whenever the commencement, progress, or completion of an activity depends upon the commencement, progress, or completion of another activity (including activities of separate contractors) and show the timely and orderly completion of all Work in accordance with the requirements of the Contract Documents, including such interim "milestone" dates as are identified therein. If not accepted, the construction schedule shall be promptly revised by the Contractor in accordance with the recommendations of the Owner, the Architect, Construction Manager, and the Project Coordinator and resubmitted for acceptance and incorporation into the project construction schedule prepared by the project coordinator.
2. Within thirty (30) days of the Notice to Proceed prepare and submit to the Project Coordinator and Construction Manager a final construction schedule in a form compatible with the requirements herein for the project Coordinator's use in submitting the final Construction Schedule.
3. Shall cooperate and participate with the Project Coordinator and the other contractors in connection with all the activities described in this section.
4. Shall notify the Project Coordinator, the Owner, and the Construction Manager in writing if the Contractor objects to the Project construction schedule, or any revision thereto, stating its objection and the reasons therefor within two (2) days after the Contractor's receipt of the Project Construction schedule or any updates or revisions to which objection is made. In the absence of such timely notice, any such objection shall be deemed waived and released and the Contractor shall comply with the Project construction schedule or revision thereto. If a timely objection is made, the Contractor and the Project Coordinator shall agree to a resolution of the objection within ten (10) days. In the absence of such agreement, the Owner may, in addition to any other rights and

remedies under the Contract Documents, appoint the Construction Manager or an independent scheduling consultant to resolve the objection, whose decision shall be final and binding upon the Contractor and the Project Coordinator. All cost and expense incurred by the Owner to resolve such objection shall be charged to and borne in equal shares by the Contractor, the Project Coordinator, and their respective Sureties.

5. Shall not be entitled to claim any damages against the Owner, nor any adjustment in the Contract Time or the Contract Sum in connection with the Project construction schedule, any revision thereto, or any resolution of an objection to either the Project construction schedule or a revision thereto; and
6. Acknowledges and agrees that the Owner has no duty or responsibility toward the Contractor to cause the Project Coordinator to perform or to competently perform its duties and that the Contractor's sole claim in the event of any failure of the Project Coordinator to perform or to competently perform its duties shall be against the Project Coordinator.
7. Should any Contractor intend or plan to complete the Work, or any portion thereof, earlier than any applicable Completion Date or the Contract Time, Contractor shall give timely and reasonable written notice of this fact to the other Contractors, Project Coordinator and Construction Manager. Project Coordinator shall have the discretion to agree to or reject such early completion plan by Contractor, subject to the rights of Contractor to litigation between prime contractors. The Project Coordinator shall have no duty or obligation to agree to or to cooperate with Contractor regarding any early completion plan or proposal by Contractor and shall not be liable for any damages of Contractor because of the rejection by Project Coordinator of said plan. Earlier completion of any portion of the work shall be promoted wherever feasible and all Contractors must cooperate and accelerate towards earlier completion of any portion of the work unless such work affects the quality of work as determined by the Construction Manager. All Contractors shall cooperate and accelerate work as determined by Project Coordinator unless quality of work is affected as determined by the Construction Manager. No claims for acceleration to complete early or to meet project schedule will be considered.

C. Contractor's Construction Schedule Updating: At monthly intervals or as requested by Owner's representative, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting. Provide an electronic copy of each monthly schedule update. Provide an indication of the total project float in the schedule on a monthly basis.
2. Include a report with updated schedule that indicates every change including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Actual Completion percentage for each activity.
4. Items not ordered by the contractor in a timely manner for incorporation into the Work will not be considered for claims by the Contractor for additional time or costs.

D. Distribution: Distribute copies of approved schedule to Architect, Construction Manager, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractors with a need-to-know schedule responsibility. Provide an electronic copy to the Construction Manager and distribute to other contractors at the direction of the Construction Manager.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

E. The Critical Path Method type construction schedule will be used to monitor job progress and as a means to make monthly payments to Contractors. Contractor will be responsible for providing all information concerning the sequencing, logic and durations of all activities as well as providing the initial logic network diagram. Once the schedule is accepted, Contractor will be responsible for providing monthly update information on logic, percent complete, actual start and finish dates, and duration changes. Contractor will <u>not</u> be required to produce the computerized printout of the schedule updates. This will be performed by Project Coordinator using information provided by Contractors. Copies of the updated schedule are to be distributed at the progress meetings by the Project Coordinator.

F. From each Contractor's initial schedule submittal and from information received at the monthly schedule update meetings, computerized and dated tabular schedule reports, or updated network diagrams, or bar charts will be produced by Project Coordinator which will be reviewed by each Contractor for accuracy and integrity. It shall at all times remain each Contractor's responsibility to schedule and direct his forces in a manner that will allow for the completion of the work within the contractual period.

G. It should be clearly understood that the initial schedule and all update information must be provided by each Contractor and that this information is a representation of the best efforts of each Contractor and his subcontractors as to how they envision the work to be accomplished. Similarly, all progress information to be provided by and through each Contractor must be an accurate representation of his or his subcontractor or supplier’s actual performance. The schedule shall at all times remain an accurate reflection of each Contractor's actual or projected sequencing of work. Once accepted, adherence to the established CPM schedule shall be obligatory upon each Contractor and his subcontractors for the work under this Contract. Owner may require each Contractor to revise the schedule if, in his judgment, the schedule does not accurately reflect the actual execution of the work, or is in violation of any provision of this CPM scheduling specification, and each Contractor shall revise the schedule as often as is necessary during the course of performance of the work without additional cost to Owner.

H. The work shall be started on the date indicated in the Notice to Proceed and shall be executed with such progress as may be required to prevent delay to other Contractors or to the general completion of the project. The work shall be executed at such times and in or on such parts of the project, and with such forces, material, and equipment, as to assure completion of the work in the time established by the Contract. Additionally, each Contractor shall, at all times, schedule and direct his work so that it provides an orderly progression of the work to completion within the specified Contract Time.

I. Each Contractor agrees that whenever it becomes apparent from the current monthly CPM Schedule update that delays to the critical path have resulted and these delays are through no fault of Owner or Owner's representatives, and hence, that the Contract completion date will not be met, or when so directed by Owner’s representative or Project Coordinator he will take some or all of the following actions at no additional cost to Owner.

1. Increase construction manpower in such quantities and crafts as will substantially eliminate the backlog of work.
2. Increase the number of working hours per shift; shifts per working day, or days per week; the amount of construction equipment; etc., or any combination of the foregoing to substantially eliminate the backlog of work.
3. Schedule activities to achieve maximum practical concurrence of accomplishment of activities and comply with the revised schedule.
4. Contractor shall submit for reviewing a written statement of the steps he intends to take to remove or arrest the delay to the schedule. If Contractor fails to submit a written statement of the steps he intends to take or fails to take such steps as required by the Contract, Owner may direct the level of effort in manpower (trades), equipment, and work schedule (overtime) to remove or arrest the delay to the critical path in the accepted schedule, and Contractor shall promptly provide such level of effort at no additional cost to Owner. In addition, should schedule delays persist, Contractor's surety will be asked to attend meetings to update the schedule.

J. In the event the Owner determines that the performance of the Work, the work of separate contractors or of the Owner has not progressed or reached the level of completion required by the Contract Documents, or the Project construction schedule, the Owner shall have the right to order the Contractor to take corrective measures necessary to expedite the progress of construction, including, without limitation: (1) working additional shifts or overtime; (2) supplying additional manpower, equipment, and facilities; (3) engaging a scheduling consultant to make recommendations concerning the corrective measures to be taken, with the cost and expense of such engagement to be borne by the Contractor, the separate contractors and their respective Sureties in such proportions as the Architect and Construction Manager may, in their sole discretion, determine to be just; and (4) other similar measures. Such measures shall continue until the progress of construction complies with the required level of completion. The Owner’s right to require such measures shall not impose upon the Owner any duty or obligation to the Contractor, its Surety, or any other party. Except as specifically provided in this paragraph, the Contractor shall not be entitled to an adjustment in the Contract Time or the Contract Sum in connection with such measures required by the Owner. If the Contractor (its agents, subcontractors, suppliers, or vendors) has not caused or contributed to the failure of construction to progress or reach the required level of completion, then the Contractor shall be entitled to a

Change order for an amount not to exceed the reasonable additional labor cost of any overtime or shift work directed by the Owner under this paragraph. If the Contractor (its agents, subcontractors, suppliers, or vendors) has caused or contributed to the failure of construction to progress or reach the required level of completion, then the Contractor and its Surety shall be liable to the Owner for any and all costs and expenses incurred by the Owner due to any measures directed by the Owner under this paragraph, including the cost of any overtime or shift work performed by the Owner or by separate contractors. The Owner may exercise the rights furnished to the Owner under this paragraph as frequently as the Owner deems necessary to ensure that the progress of construction will comply with the required level of completion. If the Contractor fails to perform its duties as the Project Coordinator adequately or to the Owner's satisfaction, the Owner may, in addition to its other rights and remedies, appoint a substitute Project Coordinator who shall act in the place and with the authority of the original Project Coordinator. In that event, the Owner may, in its sole discretion, choose one of the separate contractors or an independent consultant as the substitute Project Coordinator. The cost and expense incurred by the Owner to engage such substitute Project Coordinator shall be charged to and borne by the Contractor and its Surety.

K. The Contractor's failure to cooperate and participate with the Owner, the Architect, the Construction Manager, and separate contractors in the development and review of construction schedules and updates as provided in this section shall be a material breach of its obligations, entitling the Owner to exercise all rights and remedies under the Contract Documents and applicable law. In no event shall any revision to any construction schedule constitute the basis for an adjustment in the Contract Time or the Contract Sum unless such adjustment is agreed to by the Owner and authorized pursuant to Change Order.

L. The Project Schedule is to be used by the Contractors as a guide and all contractors and sub-contractors shall be responsible to perform work to ensure that the Project is completed by the Project Contract completion date(s) and all milestone dates established in the Contract Drawings are met. Any claims for additional costs associated with completion of the Work within the required Contract time frames will not be considered. The Contractor and all Sub-contractors who feel extra time, in any form such as shift work, overtime, and premium time, is necessary to meet Contract requirements regardless of trade should include these costs in their bids. All Contractors must recognize that although their work might not require shift, overtime, or premium timework for completion within the stipulated time frame, it may be required in order to allow other Contractors to complete within the time frame. Contractors must allow for these overtime requirements and include the costs necessary to allow the other Contractors to complete within the specified time. Failure to recognize the extra costs in his bid shall not relieve the Contractor from utilizing shift, overtime, or premium time work in performance of his Contract; all costs associated with meeting the time frames indicated in the construction schedules shall be included in the Contract Price. Construction Manager, Architect, and Owner reserve the right to withhold processing of any monthly payment applications from any contractor if schedule compliance is not being strictly adhered to. Such payment may be withheld until the Contractor makes corrective action to comply with project schedule.

M. Contractor Approval and Certification. Approval by Contractor of the preliminary CPM Construction Schedule, the final CPM schedule, and schedule updates shall be evidence of the Contractor's agreement that the proposed schedule or schedule revision to the Construction Schedule is a true and accurate representation of his plan to complete the Work, including all Change Orders that are in Contractor's possession as of the foregoing date, that the schedule or schedule revision fully complies with the requirements of the Contract Documents, that he shall prosecute the Work in accordance with this schedule revision, subject to any change therein which is implemented in accordance with the Contract Documents, and that he has met and coordinated with and obtained the acceptance or approval of said schedule revision by all other parties that are affected thereby.

3.3 NETWORK REQUIREMENTS

A. The CPM Schedule shall show the order and interdependence of activities and the sequence in which the work is to be accomplished as planned by Contractor. The basic concept of the network analysis diagram is to show how the start of a given activity is dependent on the completion of preceding activities and its completion restricts the start of succeeding activities. A time scaled precedence format will be followed. The detailed network diagram will be time scaled showing a continuous flow from left to right.

B. The CPM schedule shall include a weather calendar that contains non-working days in addition to weekend and holidays to account for anticipated inclement weather days beyond those normally anticipated for the project area.

C. Failure to include in the CPM schedule any element of Work required under the performance of this Contract shall not excuse Contractor from completing all Work required within the applicable completion time, notwithstanding Owner's network review.

D. A CPM schedule which shows a completion of any portion of the Work prior to the contractual completion date may be accepted but in no event shall be acceptable as a basis for a claim for delay or cost reimbursement against Owner or its representatives by Contractor. The period of time between the Contractor's baseline accepted CPM schedules projected completion dates and the contractual stipulated completion dates, if any, will be treated as Project Float. The Owner's right to utilize Project Float is as provided in paragraph 3.8.

E. If a review of the submitted CPM Schedule indicates a work plan which will not complete the work within the time requirements stated in the Contract, it shall be the responsibility of Contractor to revise the CPM Schedule as required and resubmit it until it is acceptable. Failure by Contractor to submit an acceptable schedule may, at Owner's sole discretion, justify the withholding of any partial payment(s) otherwise due under the Contract.

F. Acceptance of the schedule shall not constitute a representation by Owner that the work can be completed as shown on the schedule.

G. The schedules prepared by the Contractor and by the Project Coordinator, if any, under this Article shall be in the form of a CPM arrow network diagram, preferably organized by IJ nodes" and shall include: (1) a shop drawing and submittal schedule noting the relevant submittal, approval, order, fabrication, and delivery durations; (2) integration of the shop drawing and submittal schedule with the installation activity logic in order to determine the effect of delivery on installation of any items of work; (3) the planned progressions of construction work showing the activities and duration of the work of each contract phase and clearly noting any interim milestone dates; (4) the appropriate restraints in order to clearly identify the interrelationships of work and crew and trade flow; (5) logic (CPM arrow network) diagrams summarized into a summary bar chart format that is capable of displaying current progress of all Work; (6) a computerized mathematical analysis of the CPM logic with each monthly schedule responsibility, activity duration, early (target) start date, early (target) finish date, late start date, late finish date, work tasks critical to completion within the Contract Time and any interim milestone dates; and (7) crew sizes and planned labor hours for each activity shown on the schedule. The Contractor shall deliver to the Owner, upon Construction Manager's request and in the format requested by the Construction Manager, copies of all electronic files (including all schedule logic, restraints, and all other electronic data and information used to create and maintain the schedule that the Owner may request) that comprise or relate to such schedules, including the original project schedule, all schedule updates, any recovery schedules, and any schedule revisions.

H. The Project Schedule shall be submitted by the Contractor for all work. All schedule and work items must be in conformance with the project schedule requirements listed in the project manual including any phasing or other milestones provided. The Project Coordinator shall incorporate all contractors' items of work and issue project schedule. Upon written approval of the schedule by the Contractor and Construction Manager and review by the Architect, it shall with respect to time, become the essence of the Contract and the Contractor who does not comply may be held in violation of Article 8, of the General Conditions, "Delays and Extension of Time". The project schedule may be changed or revised only with the written consent of the Construction Manager, Owner, and Architect. If the Contractor does not comply with all the scheduling requirements of the Contract and timelines, the Owner reserves the right to deduct $800.00 from the Contract amount for each day that Contractor does not comply and Owner may also proceed with enforcing other requirements of the Contract including Article 2.5 of the General Conditions of the Agreement. No payment applications will be processed without an approved project schedule accepted by all contractors.

I. Any preparation, review, enforcement, and updating of the project schedule do not make Owner, Construction Manager, or Architect liable to Contractor for time, cost overruns, or schedule changes which are required to maintain project contract completion date and all milestone dates established in the Project Manual.

J. Contractor is responsible for determining the sequence and logic of activities, the time estimates of the detailed construction activities, and the means, methods, techniques, and procedures to be employed with regard to his portion of the Work. The Construction Schedule shall represent Contractor's best judgment of how he shall prosecute the Work in compliance with the requirements of the Contract Documents. Contractor shall ensure that the Construction Schedule is current and accurate and is properly and timely monitored, updated, and revised as Project conditions and the Contract Documents may require, and as may be directed by Project Coordinator.

K. Contractor shall consult with his major Subcontractors relating to the preparation of his construction plan and Construction Schedule. Major Subcontractors shall receive copies of those portions of Contractor's Construction Schedule that relate to their Work and shall be continually advised of any updates or revisions to the Construction Schedule as the Work progresses. When Contractor submits his Construction Schedule to the Project Coordinator or makes any proposed updates or revisions to such Schedule, it shall be concluded by Construction Manager, Owner, and Project Coordinator that Contractor has consulted with and has the concurrence of his major Subcontractors. Contractor shall be solely responsible for ensuring that all Subcontractors comply with the requirements of the Construction Schedule for their portions of the Work.

L. The Completion and Milestone Dates set forth in the Contract Documents represent only the major items of Work and may include interface dates with the construction activities of others. Completion and Milestone Dates are Contract requirements and are of the essence to the Contract Documents and to the coordination of the Work by the Contractor. Completion and Milestone Dates represent the latest allowable completion time for those portions of the Work to which each Date relates. The Dates are not intended to be a complete listing of all Work under the Contract Documents or of all interfaces with work performed by the Contractors or others. The Contractor shall determine the time requirements for all such interfaces and shall be responsible for planning, scheduling, and coordinating the Work in order to complete in accordance with those requirements.

3.4 SCHEDULE UPDATES

A. A monthly Schedule Update Meeting will be held one (1) week prior to the progress meeting at the construction site to review and update the CPM Schedule. Project Coordinator and Contractor will attend the Schedule Update Meeting. Actual progress of the previous month will be recorded, and scheduling of future work activities will be reviewed. The duration of activities and their logical connections may be revised as needed. Decisions made at these meetings and agreed to by all parties are binding with the exception that no contractual completion dates will be modified without formal written requests and acceptance as specified herein. Contractor must provide the following information for each update at a minimum:

1. Actual start and finish dates for all completed activities.
2. Actual start dates for all started but incomplete activities and estimated remaining durations.

B. Provide a Monthly Progress Status Report, which provides a narrative explanation of progress identified in the revised construction schedule. An electronic copy of each monthly schedule update is to be provided to the Construction Manager at the end of each month. The electronic copy is to be provided with no restrictions for viewing and analyzing using the same software with which the schedule was created. The monthly status report shall indicate the following items:

1. Summarize revisions made to the Construction Schedule since the previous submittal. Identify each task that has changed, what the change is, and the reason for the change.
2. Work completed during the reporting period.
3. A printed copy of the entire project schedule including the updated early and late dates, activity durations, predecessors and successors and a list of any logic and duration changes executed during the update period.
4. Work anticipated to be started during the next period, including those activities already in progress.
5. Problem areas, anticipated delays, and their impact on the schedule.
6. Corrective action recommended and its effect.
7. The effect of changes on schedules of other prime Contractors.
8. Updated Tabulation of Contract Time and a printed copy of the project critical path.
9. An evaluation of the overall status of the schedule for the job.

C. Application for Payment: Contractor understands and agrees that the submission and acceptance of progress updates and the receipt of progress reports are an integral part and basic element of the Applications for Payment; and that Contractor shall not be entitled to any progress payment under the Contract Documents until Contractor has fully complied with the requirements of this Section.

D. Review by the Construction Manager and Owner of Contractor's Construction Schedule, or any revisions or updates thereto, are advisory only and shall not relieve Contractor of the responsibility for accomplishing each portion of the Work within each and every applicable Completion Date. Omissions and errors in the approved

or accepted Construction Schedule, or any revisions or updates, shall not excuse performance which is not in compliance with the Contract Documents. Review by the Construction Manager does not make Owner, Architect, or Construction Manager liable to Contractor for time or cost overruns flowing from such omissions or errors.

3.5 RECOVERY SCHEDULES

A. Should the updated Construction Schedule, at any time during Contractor's performance, show, in the sole opinion of Construction Manager that any Contractor is ten (10) or more days behind schedule for any Completion Date, Contractor shall within seven (7) days after notice by Construction Manager, prepare a recovery schedule at no cost to Owner explaining and displaying how Contractor intends to reschedule his Work in order to regain compliance with the Construction Schedule during the immediate subsequent pay period. Contractor shall also coordinate schedule changes for implementation by General Contractor in overall schedule.

1. If Contractor believes that all of the time can be recovered during the subsequent pay period, Contractor shall be permitted to prepare a recovery schedule as set forth below. However, if Contractor believes it shall take more than thirty (30) days to recover all of the lost time, he shall prepare and submit a request for revision to the Construction Schedule and comply with all of the requirements of a schedule revision as set forth.
2. Contractor shall prepare and submit to the Construction Manager a limited duration recovery schedule, incorporating best available information from Subcontractors and others which shall permit return to Construction Schedule at the earliest possible time. Contractor shall prepare a recovery schedule to the same level of detail as the Construction Schedule for a maximum duration of one month. The recovery schedule shall be prepared in coordination with other Prime Contractors.
3. Within two (2) days after submission by the Contractor or by any Prime Contractor of a recovery schedule to Project Coordinator, Contractor shall participate in a conference with the Project Coordinator and Construction Manager to review and evaluate the recovery schedule. Within two (2) days of the conference, Contractor shall submit the revisions necessitated by the review for Project Coordinator's and Construction Manager’s review and acceptance. Contractor shall use the accepted recovery schedule as his plan for returning to the Construction Schedule.
4. Each Contractor shall confer continuously with the Project Coordinator to assess the effectiveness of the recovery schedule. As a result of this conference:

   a. If Construction Manager determines Contractor is still behind schedule, Project Coordinator shall direct Contractor to prepare a schedule revision with the assistance of the Project Coordinator and comply with all of the requirements of a schedule revision as stated herein and the other requirements of the Contract Documents; provided, however, that nothing herein shall limit in any way the rights and remedies of Owner and Project Coordinator as provided elsewhere in the Contract Documents; or
   b. If Project Coordinator determines Contractor has successfully complied with provisions of the recovery schedule, Project Coordinator shall direct Contractor to return to the use of the accepted Construction Schedule.

5. Nothing herein alters the obligation of Project Coordinator to resolve coordination and scheduling issues in dispute between and among Contractor and other Prime Contractors.

3.6 CAUSES FOR EXTENSIONS OF TIME

A. The Contract Times will be adjusted only for causes specified in this Contract. In the event any Contractor requests an extension of Contract Time, he shall furnish justification and supporting evidence per requests specified elsewhere in these Contract Documents. Each Contractor acknowledges and agrees that actual delays in activities, which, according to the CPM schedule, do not affect any contract completion date shown by the critical path in the network, do not have any effect on the Contract Time, and therefore will not be the basis for a change in Contract Time.

B. Contract Time extensions for weather delays will be based only on the following criteria:

1. General Requirements: Even though a cause of delay meets any, or all, of the conditions stated herein, it shall in all cases be presumed that no extension, or further extension, of time is due unless Contractor shall demonstrate that the delay is justified and had an impact to the critical path of the updated CPM schedule for the delay period. To this end, Contractor shall maintain adequate records supporting any claim for an extension of time and shall submit such records, including a revised CPM schedule showing the impact of the delay, with the claim. Claims due to weather shall be submitted on a monthly basis and within five days after the end of the previous month of such delay.
2. The Owner will determine Contractor's entitlement to an extension of the Contract Time. Daily records, maintained by the Construction Manager, shall be the official source for weather data related to precipitation and temperature. A time extension of no more than one day will be granted for one day of lost work, regardless of the number of allowable reasons for lost time. The period of any extension of time shall be only for the portion of the contract actually delayed due to the abnormal weather conditions. Any extension of Contract Time allowed shall be considered non-compensable and have no impact on Contract Price.
3. Temperatures above or below the statistical mean are not considered to be justification for an extension of Contract Time.
4. Time extensions for snow shall be based on above normal snow for the project area and only based on direct impact to the CPM schedule. Only snow days with greater than 3" of snow cover will be considered in the request for time extension.
5. Time extensions for precipitation shall be based on above normal precipitation for the project area and only based on direct impact to CPM schedule. Only workdays with precipitation greater than one-tenth inch (0.10") shall be considered in the request for time extension.

3.7 ADJUSTMENT BY OWNER

A. From time to time it may be necessary for the Contract schedule and/or Contract Times to be adjusted by Owner due to the effects of job conditions, acts or omissions of other Contractors not directly associated with this contract, act of God, technical difficulties, unavoidable delays on the part of Owner or his representatives, and other unforeseeable conditions which may indicate schedule adjustments and/or an extension of the Contract Time. Under such conditions, Owner shall direct Contractor to reschedule the work to reflect the changed conditions, and Contractor shall revise his schedule accordingly. Only the Owner in writing shall grant schedule extensions affecting the Contract Time. No additional compensation shall be made to Contractor for such schedule changes except for unavoidable overall Contract delays, in which case Contractor shall take all possible action to minimize any time extension. It is specifically noted that available Project Total or Free Float in the CPM schedule may be used by the Owner and his representative to accommodate any adjustments in time, therefore eliminating the need for a time extension.

3.8 FLOAT TIME

A. Without obligation to extend the overall completion date or any intermediate completion dates set out in the CPM network, Owner may initiate changes to the Contract work that absorb float time. Owner-initiated changes that affect the critical path on the CPM network shall be the sole grounds for extending (or shortening) said completion dates. Contractor initiated changes that encroach on the total float time identified in the CPM network may be accomplished with Owner's concurrence. Such changes, however, shall give way to Owner-initiated changes competing for the same total float time.

END OF SECTION 01 32 00

SECTION 01 32 33 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs.
2. Concealed Work photographs.
3. Periodic construction photographs.
4. Preconstruction video recordings.

B. Related Requirements:

1. Section 01 77 00 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 01 79 00 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
3. Section 02 41 19 "Selective Demolition" for photographic documentation before selective demolition operations commence.
4. Section 31 10 00 "Site Clearing" for photographic documentation before site clearing operations commence.

1.2 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph and video recording. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within three days of taking photographs.

1. Submit photos on thumb-drive or by uploading to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description in file metadata tag or in web-based Project management software site:

a. Name of Project.
b. Name and contact information for photographer.
c. Name of Architect.
d. Name of Contractor.
e. Date photograph was taken.
f. Description of location, vantage point, and direction.
g. Unique sequential identifier keyed to accompanying key plan.

C. Video Recordings: Submit video recordings within seven days of recording.

1. Submit video recordings on thumb drive or by uploading to web-based Project management software site. Include copy of key plan indicating each video's location and direction.
2. Identification: With each submittal, provide the following information in file metadata tag or on web-based Project management software site:

a. Name of Project.
b. Name and contact information for photographer.
c. Name of Architect.
d. Name of Contractor.
e. Date video recording was recorded.

f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

1.3 QUALITY ASSURANCE

A. Construction Webcam Service Provider: A firm specializing in providing photographic equipment, web-based software, and related services for construction projects, with a record of providing satisfactory services similar to those required for Project.

1.4 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels. Use flash in low light levels or backlit conditions.

B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full high-definition mode with vibration-reduction technology. Provide supplemental lighting in low light levels or backlit conditions.

C. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

D. Metadata: Record accurate date and time from camera.

E. File Names: Name media files with date, Project area, and sequential numbering suffix.

1.5 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified photographer to take construction photographs.

B. General: Take photographs with maximum depth of field and in focus.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.

1. Flag excavation areas and construction limits before taking construction photographs.
2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
3. Take 20 photographs of existing buildings either on or adjoining property, to accurately record physical conditions at start of construction.
4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

D. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:

1. Underground utilities.
2. Underslab services.
3. Piping.
4. Electrical conduit.
5. Waterproofing and weather-resistant barriers.

E. Periodic Construction Photographs: Take 20 photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken.

1.6 CONSTRUCTION VIDEO RECORDINGS

A. Preconstruction Video Recording: Before starting excavation, demolition, and construction, record video recording of Project site and surrounding properties from different vantage points, as directed by Architect.

1. Flag excavation areas and construction limits before recording construction video recordings.
2. Show existing conditions adjacent to Project site before starting the Work.
3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of excavation, demolition, and construction.
4. Show protection efforts by Contractor.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 32 33

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other miscellaneous submittals.

B. Related Sections include the following:

1. Division 01 Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Division 01 Section 013100 "Project Management and Coordination" for submitting Coordination Drawings.
3. Division 01 Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Division 01 Section 013125 “Web Based Project Management System” for making shop drawing submissions.
5. Division 01 Section 014000 "Quality Requirements" for submitting test and inspection reports and Delegated-Design Submittals and for erecting mockups.
6. Division 01 Section 017700 "Closeout Procedures" for submitting warranties Project Record Documents and operation and maintenance manuals.
7. Division 01 Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
8. Division 01 Section 019113 “General Commissioning Requirements” for additional information and procedures.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Architect’s responsive action.

B. Informational Submittals: Written information that does not require Architect's approval. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that requires sequential activity.
2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

   a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

B. Submittals Schedule: Comply with requirements in Division 01 Section 013200 "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.

C. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Concurrent Review: Where concurrent review of submittals by Architect's consultants, Owner, or other parties is required, allow 21 days for initial review of each submittal.
3. Direct Transmittal to Consultant: Where the Contract Documents indicate that submittals may be transmitted directly to Architect's consultants, provide duplicate copy of transmittal to Architect. Submittal will be returned to Architect before being returned to Contractor.
4. If intermediate submittal is necessary, process it in same manner as initial submittal.
5. Allow 15 days for processing each resubmittal.
6. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.

D. Identification: Place a permanent label or title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Include the following information on label for processing and recording action taken:

   a. Project name.
   b. Date.
   c. Name and address of Architect.
   d. Name and address of Contractor.
   e. Name and address of subcontractor.
   f. Name and address of supplier.
   g. Name of manufacturer.
   h. Unique identifier, including revision number.
   i. Number and title of appropriate Specification Section.
   j. Drawing number and detail references, as appropriate.

4. The Contractors shall utilize a 9+ character submittal identification numbering system in the following manner:

   a. The first six digits are to be the applicable Specification Section number.
   b. The next three digits shall be the numbers (001-999) to sequentially number each initial separate item submitted. The last character shall be a letter (A-Z) indicating the submission or resubmission version, i.e. “A”= initial submission, “B” = 2nd submission, “C” = 3rd submission, etc. A typical submittal number would be as follows:

      033000-008-B – (xxxx)

      033000 = Specification Section for Concrete
      008 = the eighth submittal under this specification section
      B = the second submission (first resubmission) of that particular shop drawing
      xxxx = Brief description of items in submittal

5. All submittals shall be clearly identified using the numbering system described above. Submittals items received without appropriate identification will be returned without review. The Contractor on the individual items to be reviewed and on the transmittal cover sheet under which the submittals are shipped shall provide the submittal number.

E. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals.

F. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions of the Contract Documents, initial submittal may serve as final submittal.

1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
2. Additional copies submitted for maintenance manuals will be marked with action taken and will be returned.
3. Contractor shall provide two paper copies of all final submittals as directed by CM. Otherwise, all submittals shall be provided electronically.

G. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Contractor. Architect will return any submittal not submitted individually as rejected.

1. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements of the Contract Documents, including minor variations and limitations. Include the same label information as the related submittal.
2. Include Contractor's certification stating that information submitted complies with requirements of the Contract Documents.
3. Transmittal Form: Provide locations on form for the following information:

a. Project name.
b. Date.
c. Destination (To:).
d. Source (From:).
e. Names of subcontractor, manufacturer, and supplier.
f. Category and type of submittal.
g. Submittal purpose and description.
h. Submittal and transmittal distribution record.
i. Remarks.
j. Signature of transmitter.

H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, and authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

I. No portion of the Work requiring shop drawings, samples or product data specified shall be started nor shall any material be fabricated or installed prior to approval of such item. Fabrication performed, materials purchased, or on-site construction accomplished which does not conform to approved shop drawings, submittals, or data shall be solely at the contractor risk and expense. The owner shall not be liable for any expenses or delay claims due to corrections or remedies required to accomplish conformity with this requirement.

J. Use for Construction: Use only final submittals with mark indicating action taken by Architect in connection with construction.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

1. Number of Copies: Submit copies of each submittal, as follows, unless otherwise indicated:

a. Initial Submittal: Submit a preliminary single copy of each submittal where selection of options, color, pattern, texture, or similar characteristics is required. Architect will return submittal with options selected.

b. Final Submittal: Submit not less than 5 copies unless copies are required for operation and maintenance manuals. Submit additional copies where required for operation and maintenance manuals. Architect will retain 3 copies; plus at least one additional copy if reviewed by a consultant, the remainder will be returned. Mark up and retain one returned copy as a Project Record Document.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's written recommendations.
b. Manufacturer's product specifications.
c. Manufacturer's installation instructions.
d. Standard color charts.
e. Manufacturer's catalog cuts.
f. Wiring diagrams showing factory-installed wiring.
g. Printed performance curves.
h. Operational range diagrams.
i. Mill reports.
j. Standard product operating and maintenance manuals.
k. Compliance with recognized trade association standards.
l. Compliance with recognized testing agency standards.
m. Application of testing agency labels and seals.
n. Notation of coordination requirements.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Include the following information, as applicable:

a. Dimensions.
b. Identification of products.
c. Fabrication and installation drawings.
d. Roughing-in and setting diagrams.
e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
f. Shopwork manufacturing instructions.
g. Templates and patterns.
h. Schedules.
i. Design calculations.
j. Compliance with specified standards.
k. Notation of coordination requirements.
l. Notation of dimensions established by field measurement.

2. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
3. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches.

D. Coordination Drawings: Comply with requirements in Division 01 Section 013100 "Project Management and Coordination."

E. Electronic Submittals and Shop Drawings: All submittals and shop drawings may be submitted in electronic format through the project web-based management software. Specific requirements for reducing the quantity of paper copies will be reviewed at the pre-construction meeting.

1. Submit one copy electronically. Refer to Section 013125, Article 2.3, Paragraph A.1.

2. For Shop Drawings in format larger than 11 inches by 17 inches, Contractor shall provide one hard (printed) copy to the Architect along with the required electronic material.

F. Samples: Prepare physical units of materials or products, including the following:

1. Comply with requirements in Division 01 Section 014100 "Quality Requirements" for mockups.
2. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
3. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured and finished in manner specified, and physically identical with the product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
4. Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Architect's sample where so indicated. Attach label on unexposed side that includes the following:

    a. Generic description of Sample.
    b. Product name or name of manufacturer.
    c. Sample source.

5. Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, provide the following:

    a. Size limitations.
    b. Compliance with recognized standards.
    c. Availability.
    d. Delivery time.

6. Submit Samples for review of kind, color, pattern, and texture for a final check of these characteristics with other elements and for a comparison of these characteristics between final submittal and actual component as delivered and installed.

    a. If variation in color, pattern, texture, or other characteristic is inherent in the product represented by a Sample, submit at least three (3) sets of paired units that show approximate limits of the variations.
    b. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, and details of assembly, connections, operation, and similar construction characteristics.

7. Number of Samples for Initial Selection: Submit two full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

8. Number of Samples for Verification: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.

    a. Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

9. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

G. Product Schedule or List: Prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product.
2. Number and name of room or space.
3. Location within room or space.

H. Delegated-Design Submittal: Comply with requirements in Division 01 Section 014000 "Quality Requirements."

I. Contractor's Construction Schedule: Comply with requirements in Division 01 Section 013200 "Construction Progress Documentation" for Construction Manager 's action.

J. Submittals Schedule: Comply with requirements in Division 01 Section 013200 “Construction Progress Documentation."

K. Application for Payment: Comply with requirements in Division 01 Section 012900 "Payment Procedures."

L. Schedule of Values: Comply with requirements in Division 01 Section 012900 "Payment Procedures."

M. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

N. Steel Products Procurement Act: Submit certifications including, but not limited to, invoices, bills of lading, mill certifications, and other certification required to verify compliance with the Act.

2.2 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.

1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Architect will not return copies.
2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. An officer shall sign certificates and certifications or other individual authorized to sign documents on behalf of that entity.
3. Test and Inspection Reports: Comply with requirements in Division 01 Section 014000 "Quality Requirements."

B. Contractor's Construction Schedule: Comply with requirements in Division 01 Section 013200 "Construction Progress Documentation."

C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names, and addresses of Architects and owners, and other information specified.

D. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements.

E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements and, where required, is authorized for this specific Project.

G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.

H. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements.

I. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.

J. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements.

K. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

L. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements.

M. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

N. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

O. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements in Division 01 Section 017700 "Closeout Procedures."

P. Design Data: Prepare written and graphic information including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

Q. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturers. Include the following, as applicable:

1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

R. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. REVIEW EACH SUBMITTAL AND CHECK FOR COMPLIANCE WITH THE CONTRACT DOCUMENTS. NOTE CORRECTIONS AND FIELD DIMENSIONS. MARK WITH APPROVAL STAMP BEFORE SUBMITTING TO ARCHITECT.

Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT’S ACTION

A. GENERAL: ARCHITECT WILL NOT REVIEW SUBMITTALS THAT DO NOT BEAR CONTRACTOR'S APPROVAL STAMP AND WILL RETURN THEM AT THE CONTRACTORS EXPENSE WITHOUT ACTION.

B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken.

1. NO EXCEPTION TAKEN – This action is assigned when the information provided requires no additional notes or comments on the submittal and the information provided is in general conformance with the plans and specifications. The contractor may release the equipment or material for purchase or fabrication.
2. MAKE CORRECTIONS NOTED – This action is assigned when the information provided requires only minor notes or comments be added or corrections made to the submittal and the information provided is in general conformance with the plans and specifications. For clarification, this action may include additional comments from the architect indicating the extent of changes required.
3. REJECTED – This action indicates the information provided does not meet the intent of the design or is not specified on the drawings and/or specifications. Product substitutions made in this manner will be rejected. The contractor shall NOT release any equipment or material for purchase or fabrication. The Architect will return the contents of the submittal at the contractor’s expense. The contractor shall resubmit the entire contents of the submittal.
4. SUBMIT SPECIFIED ITEM – This action assigned indicates that information is missing from the shop drawing submittal. The contractor should NOT release the equipment or material for purchase or fabrication.
5. REVISE AND RESUBMIT – This action indicates the information provided is incomplete or notes and comments are extensive enough to require a resubmittal of some or all of the information. This resubmittal is to address all comments, omissions, misrepresentations, and insufficient data that were received by the Architect. The contractor may, at their option, release the equipment or

material for purchase or fabrication or resubmit the information requested for additional action. All notations and comments must be incorporated into the final product.

C. Informational Submittals: Architect will review each submittal and will not return it or will reject and return it if it does not comply with requirements.

D. Submittals not required by the Contract Documents will not be reviewed and may be discarded. The Architect is not required to notify the sender of such action.

3.3 ELECTRONIC DOCUMENTS

A. Architect and Construction Manager will make the drawings available to the Prime Contractor after the execution of the Owner-Contractor Agreement (**DOCUMENTS ARE NOT AVAILABLE DURING BIDDING**).

B. Files will be furnished in their original software format and are not available in any other format. The Architect does not guarantee software/hardware compatibility. The Contractor will be charged a handling fee of $100 plus $25.00 per drawing sheet, payable to the Architect, this cost is non-refundable.

C. The documents provided were prepared by Architect or their consultants as instruments of service to the Owner for this Project. The Owner and the Architect do not endorse or warrant the documents as suitable for any other purpose. These documents are furnished without warranties or guarantees (express, implied, or statutory), for the accuracy, reliability, and completeness. These files may vary from the documents used during bidding and do not include modifications issued by addenda or bulletins. If there are conflicts between the electronic drawings and the bid set, the bid set shall govern.

D. In order to obtain any documents in electronic format the Prime Contractor shall submit to the Architect a letter on company letterhead which includes the following information:

1. At this time, our company is requesting the following drawings in electronic format:

    a. (List each drawing by the sheet no. as it appears in the Contract Documents).

2. In making this request for documents in electronic format our company hereby agrees to the following conditions:

    a. We agree to remove any and all identification of the Architect and consultants from title block prior to the use of the documents.
    b. We agree to add our title block or the title block of our supplier prior to reproducing the documents either electronically or in printed form.
    c. We agree that prior to reproducing any drawing, we will verify the information and dimensions contained in the documents and assume the liability for the accuracy as if the drawings had been totally prepared by our own company.
    d. We agree that the use of these electronic files is specifically for this Project, these files will not be reproduced for any other project, and the Architect has not waived the Architect's copyright or other reserved rights.
    e. We agree to release and indemnify the Owner, Architect, and Construction Manager and their consultants against any losses or claims as a result of any errors or omissions in the electronic data.
    f. This letter shall be signed by person authorized to agree to the terms of the letter and shall be accompanied by a check to cover the charge per drawing file listed above. Shipping and postage is not included in the amount stated above and will be an additional charge.
    g. Electronic files are not construction documents. Differences may exist between the electronic files and corresponding hard-copy construction documents. The Architect and Owner make no representation regarding the accuracy or completeness of the electronic files. In the event that a conflict is discovered between the hard copy construction documents and the electronic files, hard-copy construction documents shall govern. The Contractor is responsible for determining if any conflict exists.
    h. The use of the electronic files does not relieve the Contractor of fully complying with the

Contract Documents or the need to check, confirm, and coordinate all dimensions and details, take field measurements, verify field conditions, and coordinate your work with that of other contractors for the Project.

i. Under no circumstances shall delivery of the electronic files be deemed a sale. The Owner and Architect make no warranties, either express or implied, of merchantability and fitness for any particular purpose. In no event shall we be liable for any loss of profit or any consequential damages as a result of your use of these electronic files.

END OF SECTION 01 33 00

SECTION 013591 - HISTORIC TREATMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general protection and treatment procedures for designated historic spaces, areas, rooms, and surfaces in Project.

1.2 DEFINITIONS

A. Consolidate: To strengthen loose or deteriorated materials in place.

B. Design Reference Sample: A sample that represents Architect's prebid selection of work to be matched; it may be existing work or work specially produced for Project.

C. Dismantle: To disassemble or detach a historic item from a surface, or a nonhistoric item from a historic surface, using gentle methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

D. Historic: Spaces, areas, rooms, surfaces, materials, finishes, and overall appearance that are important to the successful preservation, rehabilitation, restoration, and reconstruction as determined by Architect.

E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.

F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.

G. Reinstall: To protect removed or dismantled item, repair and clean it as indicated for reuse, and reinstall it in original position, or where indicated.

H. Remove: To take down or detach a nonhistoric item located within a historic space, area, or room, using methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

I. Repair: To correct damage and defects, retaining existing materials, features, and finishes while employing as little new material as possible. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.

J. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.

K. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.

L. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.

M. Restore: To consolidate, replicate, reproduce, repair, and refinish as required to achieve the indicated results.

N. Retain: To keep an element or detail secure and intact.

O. Reversible: New construction work, treatments, or processes that can be removed or undone in the future without damaging historic materials unless otherwise indicated.

P. Salvage: To protect removed or dismantled items and deliver them to Owner, ready for reuse.

Q. Stabilize: To provide structural reinforcement of unsafe or deteriorated items while maintaining the essential form as it exists at present; also, to reestablish a weather-resistant enclosure.

R. Strip: To remove existing finish down to base material unless otherwise indicated.

1.3 COORDINATION

A. Historic Treatment Subschedule: A construction schedule coordinating the sequencing and scheduling of historic treatment work for entire Project, including each activity to be performed in historic spaces, areas, and rooms, and on historic surfaces; and based on Contractor's Construction Schedule. Secure time commitments for performing critical construction activities from separate entities responsible for historic treatment work.

1. Schedule construction operations in sequence required to obtain best historic treatment results.
2. Coordinate sequence of historic treatment work activities to accommodate the following:

   a. Other known work in progress.
   b. Tests and inspections.

3. Detail sequence of historic treatment work, with start and end dates.
4. Equipment Data: List gross loaded weight, axle-load distribution, and wheel-base dimension data for mobile and heavy equipment proposed for use. Do not use such equipment without certification from Contractor's professional engineer that the structure can support the imposed loadings without damage.

B. Pedestrian and Vehicular Circulation: Coordinate historic treatment work with circulation patterns within Project building and site. Some work is near circulation patterns. Circulation patterns cannot be closed off entirely, and in places can be only temporarily redirected around small areas of work. Plan and execute the Work accordingly.

1.4 PROJECT MEETINGS FOR HISTORIC TREATMENT

A. Preliminary Historic Treatment Conference: Before starting historic treatment work, conduct conference at Project site.

1. Attendees: In addition to representatives of Owner, Construction Manager, Architect, and Contractor, testing service representative, historic treatment specialists, chemical-cleaner manufacturer(s), and installers whose work interfaces with or affects historic treatment shall be represented at the meeting.
2. Agenda: Discuss items of significance that could affect progress of historic treatment work, including review of the following:

   a. Historic Treatment Subschedule: Discuss and finalize; verify availability of materials, historic treatment specialists' personnel, equipment, and facilities needed to make progress and avoid delays.
   b. Fire-prevention plan.
   c. Governing regulations.
   d. Areas where existing construction is to remain and the required protection.
   e. Hauling routes.
   f. Sequence of historic treatment work operations.
   g. Storage, protection, and accounting for salvaged and specially fabricated items.
   h. Existing conditions, staging, and structural loading limitations of areas where materials are stored.

i. Qualifications of personnel assigned to historic treatment work and assigned duties.
j. Requirements for extent and quality of work, tolerances, and required clearances.
k. Methods and procedures related to historic treatments, including product manufacturers' written instructions and precautions regarding historic treatment procedures and their effects on materials, components, and vegetation.
l. Embedded work such as flashings and lintels, special details, collection of wastes, protection of occupants and the public, and condition of other construction that affect the Work or will affect the work.

3. Reporting: Record conference results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.

B. Coordination Meetings: Conduct discussion for historic treatment work at the regular project meetings.

1.5 MATERIALS OWNERSHIP

A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered or uncovered during the Work, regardless of whether they were previously documented, remain Owner's property.

1. Dismantle and salvage each item or object and protect it from damage, then promptly deliver it to Owner, where directed, at Project site.

1.6 INFORMATIONAL SUBMITTALS

A. Historic Treatment Subschedule:

1. Submit historic treatment subschedule within 30 days of date established for commencement of historic treatment work.

B. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by Contractor's historic treatment operations.

C. Historic Treatment Program: Submit 30 days before work begins.

D. Fire-Prevention Plan: Submit 30 days before work begins.

1.7 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: An experienced firm regularly engaged in historic treatments similar in nature, materials, design, and extent to the work as specified in each Section and that has completed a minimum of five recent projects with a record of successful in-service performance that demonstrates the firm's qualifications to perform this work.

1. Field Supervisor Qualifications: Supervisors experienced in historic treatment work similar in nature, material, design, and extent to that indicated for this Project. Supervisors shall be on site when historic treatment work begins and during its progress. Supervisors shall not be changed during Project except for causes beyond control of the specialist firm.

a. Construct new mockups of required work whenever a supervisor is replaced.

B. Historic Treatment Program: Prepare a written plan for historic treatment for whole Project, including each phase or process and protection of surrounding materials during operations. Describe in detail the materials, methods, and equipment to be used for each phase of work. Show compliance with indicated

methods and procedures specified in this and other Sections. Coordinate this whole-Project historic treatment program with specific requirements of programs required in other historic treatment Sections.

1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.

C. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.

D. Safety and Health Standard: ANSI/ASSP A10.6.

1.8 STORAGE AND HANDLING OF HISTORIC MATERIALS

A. Identification: Photograph, tag, and catalog historic items to be salvaged or reinstalled.

1. Identify each item with a nonpermanent location identification tag indicating item name or use, location, and location identification number to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying tag.

   a. For groups of material, such as brick, provide location identification tag for pallet or container. Do not tag individually.

B. Salvaged Historic Materials:

1. Clean loose dirt and debris from salvaged historic items unless more extensive cleaning is indicated.
2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

C. Historic Materials for Reinstallation:

1. Repair and clean historic items for reuse as indicated.
2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.

D. Existing Historic Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after historic treatment and construction work in the vicinity is complete.

E. Storage: Store historic items within a weather-tight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.

1. Secure stored materials to protect from theft.
2. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 deg F (3 deg C) or more above the dew point.

F. Storage Space:

1. Owner will arrange for limited on-site location(s) for free storage of historic material.
2. Arrange for off-site locations for storage and protection of historic material that cannot be stored and protected on-site.

1.9 FIELD CONDITIONS

A. Size Limitations in Historic Spaces: Materials, products, and equipment used for performing the Work and for transporting debris, materials, and products shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by 12 inches or more.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from historic treatment procedures.

1. Use only proven protection methods, appropriate to each area and surface being protected.
2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where historic treatment work is being performed.
3. Erect temporary barriers to form and maintain fire-egress routes.
4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during historic treatment work.
5. Contain dust and debris generated by historic treatment work, and prevent it from reaching the public or adjacent surfaces.
6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.

B. Temporary Protection of Historic Materials:

1. Protect existing historic materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
2. Do not attach temporary protection to historic surfaces except as indicated as part of the historic treatment program and approved by Architect.

C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.

D. Utility and Communications Services:

1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by historic treatment work before commencing operations.
2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for historic treatment work.
3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.

3.2 PROTECTION FROM FIRE

A. Follow fire-prevention plan and the following:

1. Comply with NFPA 241 requirements unless otherwise indicated.
2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.

    a. If combustible material cannot be removed, provide fire blankets to cover such materials.

3. Prohibit smoking by all persons within Project work and staging areas.

B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:

1. Obtain Owner's approval for operations involving use of open-flame or welding or other high-heat equipment. Notify Owner at least 72 hours before each occurrence, indicating location of such work.
2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that area is safe.
4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:

    a. Train each fire watch in proper operation of fire-control equipment and alarms.
    b. Prohibit fire-watch personnel from other work that would distract from fire-watch duties.
    c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.
    d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than 30 minutes after conclusion of work in each area to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
    e. Maintain fire-watch personnel at each area of Project site until 60 minutes after conclusion of daily work.

C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for type of fire risk in each work area. Ensure that nearby personnel and fire-watch personnel are trained in fire-extinguisher and blanket use.

3.3 PROTECTION DURING APPLICATION OF CHEMICALS

A. Protect motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.

B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in historic treatment program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.

C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.

D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.

E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

3.4 GENERAL HISTORIC TREATMENT

A. Have historic treatment work performed only by qualified historic treatment specialists.

B. Ensure that supervisory personnel are present when historic treatment work begins and during its progress.

C. Record existing work before each procedure (preconstruction), and record progress during the work. Use digital preconstruction documentation photographs or video recordings. Comply with requirements in Section 01 32 33 "Photographic Documentation."

D. Perform regular inspections of Project site as the Work progresses to detect hazards resulting from historic treatment procedures.

E. Follow the procedures in subparagraphs below and procedures approved in historic treatment program unless otherwise indicated:

1. Retain as much existing material as possible; repair and consolidate rather than replace.
2. Use additional material or structure to reinforce, strengthen, prop, tie, and support existing material or structure.
3. Use reversible processes wherever possible.
4. Use historically accurate repair and replacement materials and techniques unless otherwise indicated.
5. Record existing work before each procedure (preconstruction) and progress during the work with digital preconstruction documentation photographs or video recordings. Comply with requirements in Section 01 32 33 "Photographic Documentation."

F. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.

1. Do not proceed with the work in question until directed by Architect.

G. Where missing features are indicated to be repaired or replaced, provide work with appearance based on accurate duplications rather than on conjecture, subject to approval of Architect.

H. Where work requires existing features to be removed or dismantled and reinstalled, perform these operations without damage to the material itself, to adjacent materials, or to the substrate.

I. Identify new and replacement materials and features with permanent marks hidden in the completed Work to distinguish them from original materials. Record a legend of identification marks and the locations of the items on record Drawings.

END OF SECTION 01 35 910

SECTION 01 40 00 - QUALITY REQUIREMENTS

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Prime Contractor of responsibility for compliance with the Contract Document requirements.

1. Specified tests, inspections, and related actions do not limit Prime Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
2. Requirements for Prime Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

C. Requirements of this Section relate to customized fabrication and installation procedures, not production of standard products.

1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified inspections, tests, and related actions do not limit Prime Contractor's quality-control procedures that facilitate compliance with Contract Document requirements.
3. Requirements for Prime Contractor to provide quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

D. Related Sections:

1. Division 1 Section "Cutting and Patching" specifies requirements for repair and restoration of construction disturbed by inspection and testing activities.

2. Division 1 Section "Submittals" specifies requirements for development of a schedule of required tests and inspections.

3. Divisions 02 through 33 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect Mockups: Full size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

C. Preconstruction Testing: Tests and inspections performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

E. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

H. Installer/Applicator/Erector: Prime Contractor or another entity engaged by Prime Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade or trades.

I. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five (5) previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 RESPONSIBILITIES

A. Prime Contractor Responsibilities: Unless otherwise indicated as the responsibility of another identified entity, each Prime Contractor shall provide inspections, tests, and other quality-control services specified elsewhere in the Contract Documents and required by authorities having jurisdiction. Costs for these services shall be included in the Contract Sum.

1. Unless specifically noted the individual Sections, all inspections, tests, and other quality-control services are the Prime Contractor's responsibility, the Prime Contractor shall employ and pay a qualified independent testing agency to perform quality-control services. Costs for these services shall be included in the Contract Sum.
2. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Owner's responsibility, the Owner will employ and pay a qualified independent testing agency to perform those services.

B. Retesting: The Prime Contractor is responsible for retesting where results of inspections, tests, or other quality-control services prove unsatisfactory and indicate noncompliance with Contract Document requirements, regardless of whether the original test was Prime Contractor's responsibility.

C. Associated Services: Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to, the following:
   1. Provide access to the work
   2. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
   3. Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
   4. Provide facilities for storage and curing of test samples.
   5. Deliver samples to testing laboratories.
   6. Provide the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
   7. Provide security and protection of samples and test equipment at the Project Site.

D. Coordination: Coordinate the sequence of activities to accommodate required services with a minimum of delay. Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.

1.6 INFORMATIONAL SUBMITTALS

A. Prime Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems.

   1. Seismic-force resisting system, designated seismic system, or component listed in the designated seismic system quality assurance plan prepared by the Architect.
   2. Main wind-force resisting system or a wind-resisting component listed in the wind-force-resisting system quality assurance plan prepared by the Architect.

B. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

C. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.7 REPORTS AND DOCUMENTS

A. The Prime Contractor's independent testing agency shall submit a certified written report, in duplicate, of each inspection, test, or similar service to the Architect.
   1. Submit additional copies of each written report directly to the governing authority, when the authority so directs

B. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Written reports of each inspection, test, or similar service include, but are not limited to, the following:

   1. Date of issue.
   2. Project title and number.
   3. Name, address, and telephone number of testing agency.
   4. Dates and locations of samples and tests or inspections.
   5. Names of individuals making tests and inspections.
   6. Description of the Work and test and inspection method.
   7. Identification of product and Specification Section.
   8. Complete test or inspection data.
   9. Test and inspection results and an interpretation of test results.

10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and re-inspecting.

C. Manufacturer's Field Reports: Prepare written information documenting tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.8 QUALITY ASSURANCE

A. Qualifications for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, that are prequalified as complying with the American Council of Independent Laboratories' "Recommended Requirements for Independent Laboratory Qualification" and that specialize in the types of inspections and tests to be performed.

1. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the state where the Project is located
2. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
3. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
4. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

5. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
6. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
7. Registered Engineer Qualifications: A registered Engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing Engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or products that are similar to those indicated for this Project in material, design, and extent.
8. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

    a. Requirement for specialists shall not supersede building codes and similar regulations governing the Work, nor interfere with local trade-union jurisdictional settlements and similar conventions.

B. Duties of the Testing Agency: The independent agency engaged to perform inspections, sampling, and testing of materials and construction specified in individual Sections shall cooperate with the Architect and the Prime Contractor in performance of the agency's duties. The testing agency shall provide qualified personnel to perform required inspections and tests.

1. The agency shall notify the Architect and the Prime Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. The agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work.
3. The agency shall not perform any duties of the Prime Contractor.

C. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Prime Contractor responsibilities include the following:

a. Provide test specimens representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
When testing is complete, remove test specimens, assemblies, mockups; do not reuse products on Project

1.9 QUALITY CONTROL

A. Contractor Responsibilities: Unless otherwise indicated, provide quality-control services specified and required by authorities having jurisdiction.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

a. Contractor shall not employ the same entity engaged by Owner, unless agreed to in writing by Owner.

2. Notify testing agencies at least 72 hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. Special Tests and Inspections: Owner will engage a testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner.

1. Testing agency will notify Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
2. Testing agency will submit a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
3. Testing agency will submit a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
4. Testing agency will interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
5. Testing agency will retest and reinspect corrected work at the expense of the Contractor.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.

D. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents.

E. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field-curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

F. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

G. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for the Notice to Proceed.

1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section.

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Prime Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 42 00 – REFERENCE STANDARDS AND DEFINITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Prime Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A request or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated." Location is not limited.

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. “Installer": An installer is the Prime Contractor or another entity engaged by the Prime Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, or similar operations. Installers are required to be experienced in the operations they are engaged to perform.

J. The term "experienced," when used with an entity means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1. Trades: Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.

2. Assigning Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in those operations. The specialists must be engaged for those activities, and their assignments are requirements over which the Prime Contractor has no option. However, the ultimate responsibility for fulfilling contract requirements remains with the Prime Contractor.

a. This requirement shall not be interpreted to conflict with enforcing building codes and similar regulations governing the Work. It is also not intended to interfere with local trade-union jurisdictional settlements and similar conventions

K. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

L. “Testing Agencies": A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

M. “Addenda”: Written or graphic instruments issued prior to the execution of the Agreement which modify or interpret the Contract Documents, Drawings, and Specifications, by additions, deletions, clarifications, or corrections.

N. “Bid”: The offer or proposal of the Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

O. “Bidder”: Any person, firm, or corporation submitting a Bid for the Work.

P. “Bonds”: Bid, Performance, and Payment Bonds and other instruments of surety, furnished by the Contractor and the Contractor’s surety in accordance with the Contract Documents.

Q. “Change Order”: A written order to the Contractor authorizing an addition, deletion, or revision in the Work within the general scope of the Contract Documents, or authorizing an adjustment in the Contract Price or Contract Time.

R. “Contract Documents”: The contract, including Advertisement for Bids, Information for Bidders, Bid, Bid Bond, Agreement, Payment Bond, Performance Bond, Notice of Award, Notice to Proceed, Change Order, Drawings, Specifications, and Addenda.

S. “Contract Price”: The total monies payable to the Contractor under the terms and conditions of the Contract Documents.

T. “Contract Time”: The number of calendar days stated in the Contract Documents for the completion of the Work.

U. “Contractor”: The person, firm, or corporation named as such in the Contract Documents.

V. “Drawings”: The parts of the Contract Documents which show the characteristics and scope of the Work to be performed and which have been prepared or approved by the Construction Manager.

W. “Engineer/Construction Manager”: The person, firm, or corporation named as such in the Contract Documents.

X. “Field Order”: A written order effecting a change in the Work not involving an adjustment in the Contract Price or an extension of the Contract Time, issued by the Construction Manager to the Contractor during construction.

Y. “Notice of Award”: The written notice of the acceptance of the Bid from the Owner to the successful Bidder.

Z. “Notice to Proceed”: Written communications issued by the Owner to the Contractor authorizing him/her to proceed with the Work and establishing the date for commencement of the Work.

AA. “Owner”: A public or quasi-public body or authority, corporation, association, partnership, or an individual for whom the Work is to be performed.

BB. “Project”: The undertaking to be performed as provided in the Contract Documents.

CC. “Resident Project Representative”: The authorized representatives of the Owner who is assigned to the Project site of any part thereof.

DD. “Shop Drawings”: All drawings, diagrams, illustrations, brochures, schedules and other data which are prepared by the Contractor, a Subcontractor, manufacturer, supplier or distributor, which illustrate how specific portions of the Work shall be fabricated or installed.

EE. “Specifications”: A part of the Contract Documents consisting of written descriptions of a technical nature of materials, equipment, construction systems, standards and workmanship.

FF. “Subcontractor”: An individual, firm, or corporation having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the site.

GG. “Substantial Completion”: The date certified by the Construction Manager when the construction of the Project or a specified part thereof is sufficiently completed, in accordance with the Contract Documents, so that the Project or specified part can be utilized for the purpose for which it is intended.

HH. “Supplemental General Conditions”: Modifications to General Conditions required by a Federal agency for participation in the Project and approved by the agency in writing prior to inclusion in the Contract Documents, or such requirements that may be imposed by applicable state laws.

II. “Supplier”: Any person or organization who supplies materials or equipment for the Work, including that fabricated to a special design, but who does not perform labor at the site.

JJ. “Work”: All labor necessary to produce the construction required by the Contract Documents, and all materials and equipment incorporated or to be incorporated in the Project.

KK. “Written Notice”: Any notice to any party of the Agreement relative to any 1 part of this Agreement in writing and considered delivered and the service thereof completed, when posted by certified or registered mail to the said party at their last given address or delivered in person to said party or their authorized representative on the Work.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Conflicting Requirements: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

D. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities

indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

AA	Aluminum Association, Inc. (The)
AAADM	American Association of Automatic Door Manufacturers
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ABAA	Air Barrier Association of America
ABMA	American Bearing Manufacturers Association
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies, Inc. (The)
AF&PA	American Forest & Paper Association
AGA	American Gas Association
AGC	Associated General Contractors of America (The)
AHA	American Hardboard Association (Now part of CPA)
AHAM	Association of Home Appliance Manufacturers
AI	Asphalt Institute
AIA	American Institute of Architects (The)
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALCA	Associated Landscape Contractors of America (Now PLANET - Professional Landcare Network)
ALSC	American Lumber Standard Committee, Incorporated
AMCA	Air Movement and Control Association International, Inc.
ANSI	American National Standards Institute
AOSA	Association of Official Seed Analysts, Inc.
APA	Architectural Precast Association

APA	APA - The Engineered Wood Association
APA EWS	APA - The Engineered Wood Association; Engineered Wood Systems (See APA - The Engineered Wood Association)
API	American Petroleum Institute
ARI	Air-Conditioning & Refrigeration Institute
ARMA	Asphalt Roofing Manufacturers Association
ASCE	American Society of Civil Engineers
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	ASME International (American Society of Mechanical Engineers International)
ASSE	American Society of Sanitary Engineering
ASTM	ASTM International (American Society for Testing and Materials International)
AWCI	Association of the Wall and Ceiling Industry
AWCMA	American Window Covering Manufacturers Association (Now WCMA)
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association (Formerly: American Wood Preservers' Association)
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association (The)
BICSI	BICSI, Inc.
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International)
BISSC	Baking Industry Sanitation Standards Committee
BWF	Badminton World Federation (Formerly: IBF - International Badminton Federation)
CCC	Carpet Cushion Council
CDA	Copper Development Association
CEA	Canadian Electricity Association
CEA	Consumer Electronics Association
CFFA	Chemical Fabrics & Film Association, Inc.

CGA	Compressed Gas Association
CIMA	Cellulose Insulation Manufacturers Association
CISCA	Ceilings & Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CRRC	Cool Roof Rating Council
CPA	Composite Panel Association
CPPA	Corrugated Polyethylene Pipe Association
CRI	Carpet and Rug Institute (The)
CRSI	Concrete Reinforcing Steel Institute
CSA	Canadian Standards Association
CSA	CSA International (Formerly: IAS - International Approval Services)
CSI	Cast Stone Institute
CSI	Construction Specifications Institute (The)
CSSB	Cedar Shake & Shingle Bureau
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute)
DHI	Door and Hardware Institute
EIA	Electronic Industries Alliance
EIMA	EIFS Industry Members Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ESD	ESD Association (Electrostatic Discharge Association)
ETL SEMCO	Intertek ETL SEMCO (Formerly: ITS - Intertek Testing Service NA)
FIBA	Federation Internationale de Basketball (The International Basketball Federation)
FIVB	Federation Internationale de Volleyball (The International Volleyball Federation)
FM Approvals	FM Approvals LLC
FM Global	FM Global (Formerly: FMG - FM Global)
FMRC	Factory Mutual Research (Now FM Global)

FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.
FSA	Fluid Sealing Association
FSC	Forest Stewardship Council
GA	Gypsum Association
GANA	Glass Association of North America
GRI	(Part of GSI)
GS	Green Seal
GSI	Geosynthetic Institute
HI	Hydraulic Institute
HI	Hydronics Institute
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)
HPVA	Hardwood Plywood & Veneer Association
HPW	H. P. White Laboratory, Inc.
IAS	International Approval Services (Now CSA International)
IBF	International Badminton Federation (Now BWF)
ICEA	Insulated Cable Engineers Association, Inc.
ICRI	International Concrete Repair Institute, Inc.
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The)
IESNA	Illuminating Engineering Society of North America
IEST	Institute of Environmental Sciences and Technology
IGCC	Insulating Glass Certification Council
IGMA	Insulating Glass Manufacturers Alliance
ILI	Indiana Limestone Institute of America, Inc.
ISO	International Organization for Standardization Available from ANSI
ISSFA	International Solid Surface Fabricators Association
ITS	Intertek Testing Service NA (Now ETL SEMCO)
ITU	International Telecommunication Union
KCMA	Kitchen Cabinet Manufacturers Association
LMA	Laminating Materials Association

	(Now part of CPA)
LPI	Lightning Protection Institute
MBMA	Metal Building Manufacturers Association
MFMA	Maple Flooring Manufacturers Association, Inc.
MFMA	Metal Framing Manufacturers Association, Inc.
MH	Material Handling (Now MHIA)
MHIA	Material Handling Industry of America
MIA	Marble Institute of America
MPI	Master Painters Institute
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
NAAMM	National Association of Architectural Metal Manufacturers
NACE	NACE International (National Association of Corrosion Engineers International)
NADCA	National Air Duct Cleaners Association
NAGWS	National Association for Girls and Women in Sport
NAIMA	North American Insulation Manufacturers Association
NBGQA	National Building Granite Quarries Association, Inc.
NCAA	National Collegiate Athletic Association (The)
NCMA	National Concrete Masonry Association
NCPI	National Clay Pipe Institute
NCTA	National Cable & Telecommunications Association
NEBB	National Environmental Balancing Bureau
NECA	National Electrical Contractors Association
NeLMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NETA	InterNational Electrical Testing Association
NFHS	National Federation of State High School Associations
NFPA	NFPA (National Fire Protection Association)
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NLGA	National Lumber Grades Authority

NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association)
NOMMA	National Ornamental & Miscellaneous Metals Association
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	NSF International (National Sanitation Foundation International)
NSSGA	National Stone, Sand & Gravel Association
NTMA	National Terrazzo & Mosaic Association, Inc. (The)
NTRMA	National Tile Roofing Manufacturers Association (Now TRI)
NWWDA	National Wood Window and Door Association (Now WDMA)
OPL	Omega Point Laboratories, Inc. (Now ITS)
PCI	Precast/Prestressed Concrete Institute
PDCA	Painting & Decorating Contractors of America
PDI	Plumbing & Drainage Institute
PGI	PVC Geomembrane Institute
PLANET	Professional Landcare Network (Formerly: ACLA - Associated Landscape Contractors of America)
PTI	Post-Tensioning Institute
RCSC	Research Council on Structural Connections
RFCI	Resilient Floor Covering Institute
RIS	Redwood Inspection Service
SAE	SAE International
SDI	Steel Deck Institute
SDI	Steel Door Institute
SEFA	Scientific Equipment and Furniture Association
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)
SGCC	Safety Glazing Certification Council
SIA	Security Industry Association
SIGMA	Sealed Insulating Glass Manufacturers Association (Now IGMA)
SJI	Steel Joist Institute

SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SMPTE	Society of Motion Picture and Television Engineers
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division)
SPIB	Southern Pine Inspection Bureau (The)
SPRI	Single Ply Roofing Industry
SSINA	Specialty Steel Industry of North America
SSPC	SSPC: The Society for Protective Coatings
STI	Steel Tank Institute
SWI	Steel Window Institute
SWRI	Sealant, Waterproofing, & Restoration Institute
TCA	Tile Council of America, Inc. (Now TCNA)
TCNA	Tile Council of North America, Inc.
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
TMS	The Masonry Society
TPI	Truss Plate Institute, Inc.
TPI	Turfgrass Producers International
TRI	Tile Roofing Institute
UL	Underwriters Laboratories Inc.
UNI	Uni-Bell PVC Pipe Association
USAV	USA Volleyball
USGBC	U.S. Green Building Council
USITT	United States Institute for Theatre Technology, Inc.
WASTEC	Waste Equipment Technology Association
WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association
WCSC	Window Covering Safety Council (Formerly: WCMA - Window Covering Manufacturers Association)
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association)
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California)

WIC	Woodwork Institute of California (Now WI)
WMMPA	Wood Moulding & Millwork Producers Association
WSRCA	Western States Roofing Contractors Association
WWPA	Western Wood Products Association

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list.

IAPMO	International Association of Plumbing and Mechanical Officials
ICC	International Code Council
ICC-ES	ICC Evaluation Service, Inc.
UBC	Uniform Building Code (See ICC)

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CE	Army Corps of Engineers
CPSC	Consumer Product Safety Commission
DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FDA	Food and Drug Administration
GSA	General Services Administration
HUD	Department of Housing and Urban Development
LBL	Lawrence Berkeley National Laboratory
NCHRP	National Cooperative Highway Research Program (See TRB)
NIST	National Institute of Standards and Technology
OSHA	Occupational Safety & Health Administration
PBS	Public Buildings Service (See GSA)
PHS	Office of Public Health and Science
RUS	Rural Utilities Service

	(See USDA)
SD	State Department
TRB	Transportation Research Board
USDA	Department of Agriculture
USPS	Postal Service

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities Available from U.S. Access Board
CFR	Code of Federal Regulations Available from Government Printing Office
DOD	Department of Defense Military Specifications and Standards Available from Department of Defense Single Stock Point
DSCC	Defense Supply Center Columbus (See FS)
FED-STD	Federal Standard (See FS)
FS	Federal Specification Available from Department of Defense Single Stock Point Available from Defense Standardization Program Available from General Services Administration Available from National Institute of Building Sciences
FTMS	Federal Test Method Standard (See FS)
MIL	(See MILSPEC)
MIL-STD	(See MILSPEC)
MILSPEC	Military Specification and Standards Available from Department of Defense Single Stock Point
UFAS	Uniform Federal Accessibility Standards Available from Access Board

E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CBHF	State of California, Department of Consumer Affairs Bureau of Home Furnishings and Thermal Insulation
CCR	California Code of Regulations

CPUC	California Public Utilities Commission
TFS	Texas Forest Service: Forest Resource Development

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00

SECTION 01 43 39 - MOCKUPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Integrated exterior mockups.

B. Related Requirements:

1. Section 01 40 00 "Quality Requirements" for quality assurance requirements for aesthetic and workmanship mockups specified in other Sections.

1.2 DEFINITIONS

A. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as consisting of multiple products, assemblies, and subassemblies.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Construction Manager, testing and inspecting agency representative, and installers of major systems whose Work is included in integrated exterior and mockups.
2. Review coordination of equipment and furnishings provided by the Owner for room mockups.
3. Review locations and extent of mockups.
4. Review testing procedures to be performed on mockups.
5. Review and finalize schedule for mockups, and verify availability of materials, personnel, equipment, and facilities needed to complete mockups and testing and maintain schedule for the Work.

1.4 ACTION SUBMITTALS

A. Shop Drawings: For integrated exterior and mockups.

1. Include plans, elevations, sections, and mounting attachment and support details.
2. Indicate manufacturer and model number of individual components, subassemblies, and assemblies.
3. Include site location drawing indicating orientation of mockup.
4. Revise and resubmit Shop Drawings to reflect approved modifications in details and component interfaces resulting from changes made during testing procedures.

B. Delegated Design Submittal: For temporary structural supports for mockups not attached to building structure, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Preconstruction Test Reports: For integrated exterior mockups.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and acceptable to Owner, Architect, and Construction Manager.

B. Build mockups to do the following:

1. Verify selections made under Sample submittals.
2. Demonstrate aesthetic effects.
3. Demonstrate the qualities of products and workmanship.
4. Demonstrate acceptable coordination between components and systems.
5. Perform preconstruction testing, such as window air- and water-leakage testing.

C. Fabrication: Before fabricating or installing portions of the Work requiring mockups, build mockups for each form of construction and finish required. Use materials and installation methods as required for the Work.

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed unless otherwise indicated.

D. Notifications:

1. Notify Construction Manager and Architect seven days in advance of the dates and times when mockups will be constructed.
2. Notify Construction Manager and Architect 14 days in advance of the dates and times when mockups will be tested.
3. Allow seven days for initial review and each re-review of each mockup.

E. Approval: Obtain Architect's approval of mockups before starting fabrication or construction of corresponding Work.

1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 COORDINATION

A. Coordinate schedule for construction of mockups, so construction, testing, and review of mockups do not impact Project schedule.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design support structure for free-standing mockups.

B. Mockup Testing Performance Requirements: Perform tests using design pressures and performance criteria indicated for assemblies and products that are specified in other Sections and incorporated into integrated exterior mockups.

2.2 INTEGRATED EXTERIOR MOCKUPS

A. Construct integrated exterior mockups as indicated on Drawings. Construct mockups to demonstrate constructability, coordination of trades, and sequencing of Work; and to ensure materials, components, subassemblies, assemblies, and interfaces integrate into a system complying with indicated performance and aesthetic requirements.

B. Design and construct foundation and superstructure to support free-standing integrated exterior mockups.

C. Build integrated exterior mockups using installers and construction methods that will be used in completed construction.

D. Use specified products that have been approved by Architect. Coordinate installation of materials and products specified in individual Specification Sections that include Work included in integrated exterior mockups.

E. The Work of integrated exterior mockups includes, but is not limited to, the following:

1. Precast architectural concrete.
2. Masonry veneer.
3. Stone cladding.
4. Cold-formed metal framing and sheathing.
5. Air and weather barriers.
6. Thermal insulation.
7. Through-wall flashing.
8. Flashing and sheet metal trim.
9. Joint sealants.
10. Metal wall panels.
11. Aluminum-framed entrances and storefront.
12. Glazed curtain walls.
13. Aluminum windows.
14. Glazing.

F. Photographic Documentation: Document construction of integrated exterior mockups with photographs in accordance with Section 01 32 33 "Photographic Documentation." Provide photographs showing details of interface of different materials and assemblies.

1. Document testing procedures, including water leakage and other deficiencies. Photograph modifications to component interfaces intended to correct deficiencies.

G. Provide and document modifications to construction details and interfaces between components and systems required to properly sequence the Work, or to pass performance testing requirements. Obtain Architect's approval for modifications.

H. Retain approved mockups constructed in place. Incorporate fully into the Work.

PART 3 - EXECUTION

3.1 TESTING OF INTEGRATED EXTERIOR MOCKUPS

A. Integrated Exterior Mockup Testing Agency: Owner will engage Engage a qualified testing agency to perform tests and inspections.

1. Testing and inspecting agency will interpret tests and state in each report whether tested Work complies with or deviates from requirements.

B. Integrated Exterior Mockup Testing Services: Perform the following tests in the following order:

1. Water-Spray Test: Before installation of interior finishes has begun, test areas designated by Architect in accordance with AAMA 501.2 for evidence of water penetration.

   a. Perform a minimum of three (3) tests in areas as directed by Architect.

2. Air Leakage: Test in accordance with ASTM E783 at 1.5 times the rate specified in "Mockup Testing Performance Requirements" Paragraph in "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

   a. Perform a minimum of three (3) tests in areas as directed by Architect.

3. Water Penetration: Test in accordance with ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Mockup Testing Performance Requirements" Paragraph in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and verify no evidence of water penetration.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections, and also to observe testing for the following systems and assemblies.

1. Storefront as outlined in Division 8.
2. As noted elsewhere in the specifications.

D. Integrated exterior mockup will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 01 43 39

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS AND REQUIREMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 01 10 00 "Summary" for work restrictions.

C. Section 01 12 50 "Multiple Contract Summary".

1.2 SUMMARY

A. This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.

B. Temporary utilities include, but are not limited to, the following:

1. Sewers and drainage.
2. Water service and distribution.
3. Sanitary facilities, including toilets, wash facilities, and drinking-water facilities.
4. Heating, ventilation and cooling facilities.
5. Electric power service.
6. Lighting.
7. Internet service.

C. Support facilities include, but are not limited to, the following:

1. Project identification and temporary signs.
2. Waste disposal facilities.
3. Storage and fabrication sheds.
4. Lifts and hoists.
5. Construction aids and miscellaneous services and facilities.
6. Temporary Stairs
7. Dewatering facilities and drains.
8. Snow removal of construction site.
9. Weed trimming and grass cutting of construction site.

D. Security and protection facilities include, but are not limited to, the following:

1. Environmental protection.
2. Stormwater control.
3. Tree and plant protection.
4. Pest control.
5. Site enclosure fence.
6. Security enclosure and lockup.
7. Barricades, warning signs, and lights.
8. Shoring and trenching protections
9. Temporary enclosures.
10. Temporary partitions.
11. Fire protection.
12. Site security lighting.
13. Temporary signage including pedestrian and traffic signage.

14. Temporary line striping and directional markings.

E. Related Sections include the following:

1. Section 011250 "Multiple Contract Summary".
2. Section 013300 "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
3. Section 017300 "Execution Requirements" for progress cleaning requirements.
4. Section 018119, “Indoor Air Quality Requirements” for additional requirements.
5. Section 019113 “General Commissioning Requirements” for additional information and procedures.
6. Divisions 23 through 28 for temporary heat, ventilation, and humidity requirements for products in those Sections.
7. Division 32 Sections for construction and maintenance of asphalt paving and cement concrete pavement for temporary roads and paved areas.

1.3 DEFINITIONS

A. Permanent Enclosure: As determined by Architect and Construction Manager, permanent or temporary roofing is complete, insulated, and weathertight; exterior stud and/or masonry walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures which will affect the retention of heat within the structure.

1.4 DIVISION OF RESPONSIBILITIES

A. General: Each Prime Contractor is assigned specific responsibilities for certain temporary services and facilities used by other prime Contractors, and other entities at the site. The Contractor for General Construction is responsible for providing temporary services and facilities that are not normal construction activities of other prime Contractors and are not specifically assigned otherwise. All contractors must review this entire Specification for temporary requirements in each Contract.

B. EACH PRIME CONTRACTOR is responsible for:

1. Installation, operation, maintenance and removal of each temporary service or facility usually considered at its own normal construction activity, as well as the costs and use charges associated with each such service or facility.
2. Plug-in electric power cords and extension cords, and supplementary plug-in task lighting and special lighting necessary exclusively for its own activities.
3. Its own field office, complete with necessary furniture, utilities and internet service.
4. Its own storage and fabrication sheds.
5. Heat, ventilation, humidity control and enclosure of the building where these utilities are necessary exclusively for its own activities.
6. Temporary heat as required over the supplied 60-degrees F.
7. General hoisting facilities and all hoisting requirements, including hoisting loads in excess of 2-ton, hoisting material or equipment into spaces below grade, and hoisting requirements outside the building enclosure.
8. Collection and disposal of its own hazardous, dangerous, unsanitary or other harmful waste material.
9. Secure lockup of its own tools, materials and equipment.
10. Construction aids and miscellaneous services and facilities necessary exclusively for its own construction activities.
11. Collection and disposal of fluid wastes, including any water containing effluents with or without solids until permanent sewer systems are functional and if permanent systems are equipped and/or permitted to accept such effluents.
12. Separation and disposal of solids prior to release into permanent sewer system.
13. Contractor’s responsibility is to perform regular clean up and place construction debris in designated container. Refer to Waste Disposal and Clean Up, Article 3.4.G.
14. Contractor is responsible for management and disposal of all waste generated from all construction activities.

15. Each Prime Contractor is responsible for removal of their respective waste from new building construction, existing building selective demolition, sitework demolition and all site work related activities and shall follow procedures to direct as much waste as possible from the landfill.
16. Each Prime Contractor shall perform regular cleanup of construction waste to keep a clean and safe construction site. Construction Manager will re-assign clean up to other contractors and charge the contractor who is not performing the regular cleanup.
17. Waste disposal support as per Article 3.G.

C. The Contractor for General Construction is responsible for:

1. Temporary facilities and controls that are not otherwise specifically assigned to the Plumbing Contract, Mechanical Contract and Electrical Contract.
2. Unpiped sewers and drainage, including drainage ditches, dry wells, stabilization ponds, and containers.
3. Stormwater control.
4. Unpiped temporary toilet fixtures, wash facilities, and drinking water facilities, including disposable supplies.
5. Temporary field offices for the Construction Manager (CM) and project meeting office.
6. Temporary roads and paving.
7. Temporary toilets, including disposable supplies.
8. Temporary wash facilities, including disposable supplies.
9. Containerized bottled-water type drinking water units for the CM field office.
10. Temporary enclosure of the building.
11. Temporary partitions.
12. Temporary fire protection and temporary fire extinguishers.
13. Temporary heating, ventilation and air conditioning (HVAC) and humidity control from the Notice to Proceed to scheduled Substantial Completion.
14. Rodent and pest control.
15. Temporary signage including Pedestrian and traffic, Barricades, warning signs and lights.
16. Site enclosure fences including around Contractor parking and storage area (chain link fence).
17. Site and building security.
18. Temporary sidewalks and fencing.
19. Security enclosure and lockup.
20. Environmental protection.
21. Site temporary water service, water trucks, and site water systems until new water service is installed.
22. Dewatering facilities and drains for all site and building areas until permanent systems are installed.
23. Temporary stairs for construction worker access.
24. Traffic controls.
25. Weekly and as-needed street sweeping as directed by CM due to the accumulation of dirt and debris.
26. Coordination of Construction Waste Disposal for the Project for all contractors and facilities required to implement a Construction Waste Management Plan for the project in accordance with Section 017419 for all contractors.
27. Maintenance of all erosion and sediment controls per the erosion and sediment drawings. The County Conservation District has final decision in all related E&S requirements and maintenance needs.
28. Project identification, temporary signs and traffic controls.
29. Control and coordination of fire watch activities.
30. Protection of existing finishes to remain.
31. Snow removal and clearing of the site to provide access to all construction work areas, construction parking, and staging areas at all times.
32. Trimming and clearing of all weeds and grass cutting in the construction site to maintain a clean, organized site at all times.
33. Temporary partitions compliant with Hospital-grade ICRA requirements. Maintain negative air pressure in the Construction Work Area.

D. The Plumbing/Fire Protection Contractor is responsible for:

1. Piped temporary water service distribution from the new water service when it is within 5 feet of building.
2. Temporary sewers and drainage.

3. Dewatering facilities and drains for all work that is Plumbing Contractors responsibilities and once permanent construction is installed (e.g. once permanent deck or waterproof decking is installed).
4. Temporary fire hoses and signs.
5. Security enclosure and lockup in coordination with the General Contractor.
6. Piped storm water from roof sections as schedule dictates.
7. Piped temporary toilet fixtures, wash facilities, and drinking water facilities.
8. Plumbing connections to existing systems and temporary facilities and controls furnished by the General Construction Contract, Plumbing Contract, Mechanical Contract, and Electrical Contract.

E. The Heating, Ventilating and Air-Conditioning (HVAC) Contractor is responsible for:

1. Temporary gas service for heating requirements of HVAC Contractor only.
2. Security enclosure and lockup in coordination with General Contractor.
3. Dewatering and drainage for Work under scope.

F. The Electrical Contractor is responsible for:

1. Temporary electric power service and distribution. This includes office trailer services and distribution for each of the Prime Contractors and the Construction Manager. Coordinate temporary service requirements with the Construction Manager and the Energy Company.
2. Temporary lighting for building and site.
3. Power lines and outlets for temporary electric water coolers.
4. Connections for illuminated signs.
5. Temporary internet service to CM trailer.
6. Data and telecommunications conduit and wiring and service CM trailer.
7. Security enclosure and lockup in coordination with the General Prime Contractor.
8. Dewatering and drainage for work under scope.
9. Electrical connections to existing systems and temporary facilities and controls furnished by the General Construction Contract, Plumbing Contract, Mechanical Contract and Electrical Contract.

1.5 USE CHARGES AND OUTLINE REQUIREMENTS

A. General: Cost or use charges for required temporary facilities shall be included in the total Contract Sum are not chargeable to Owner, Construction Manager, or Architect as extra costs. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:

1. Owner's construction forces.
2. Occupants of Project.
3. Architect and Construction Manager (CM).
4. Testing agencies.
5. Personnel of authorities having jurisdiction.

B. Water Service: General Contractor shall be responsible for all water needs on project, from a water truck, temporary service as shown on the Phasing Drawings, or from new water service, from Notice to Proceed and until new permanent water service is installed and metered to building site. Owner will pay for metered use charges for the Project once the permanent system is installed, tested and accepted by Water Authority.

C. Sewer Service: Each individual Contractor shall be responsible for collecting and disposing of any water containing solids or other effluents with or without solids that are to be disposed of as a function of their work until the permanent septic or sewer system is fully functional and operational. Any effluents not permitted to be discharged into sewer or septic system shall be collected and disposed of by each Contractor responsible for generating the discharge.

D. Electric Service: Electrical Contractor shall furnish and install temporary power service for construction activities. Owner shall pay for all metered use charges from temporary service. Once permanent service is active, Owner will pay for use charges for permanent service.

E. Internet Service: Electrical Contractor shall furnish and pay for a 5G Hotspot internet service for CM use only at the Project site.

F. Electrical Contractor shall provide internet service/power to site monitoring camera and video storage system as specified.

G. HVAC System:

1. General Contractor shall provide temporary HVAC systems and pay for all HVAC costs for all building areas from Notice to Proceed until Substantial Completion.
2. Utility costs for any approved temporary HVAC system provided by HVAC contractor in the ninety (90) day prior to Substantial Completion period shall be paid by the Owner provided that the temporary HVAC equipment is connected to the permanent HVAC system.
3. General Contractor is responsible to protect any existing HVAC systems indicated to remain.
4. General Contractor is responsible to provide any supplemental HVAC equipment, including humidification and/or dehumidification equipment, that is necessary for the installation of new construction and finishes and maintaining equipment in place until Substantial Completion.
5. Owner will not be responsible for any costs for servicing, maintaining or operating temporary or permanent systems until after Substantial Completion of each phase.
6. HVAC Contractor must maintain, operate and extend equipment warranties as required to provide the Owner with a new, clean system with all warranty periods in effect as required by the Contract Documents.
7. HVAC Contractor shall provide a filter change after the date of Substantial Completion. Reference Section 018119, Indoor Air Quality Management for filter requirements.
8. HVAC Contractor shall comply with all the requirements of Article 3.2.G.
9. HVAC Contractor shall provide all necessary controls for safety requirements including smoke or fire monitoring, and with all necessary shutdown features to run and operate temporary or permanent HVAC systems.

H. Clarification of Utility Use Charges:

1. The Owner will pay for utility company metered electrical usage for construction activities and for one job trailer for each prime contractor.
2. The General Contractor will pay for communication usage of the Construction Manager.
3. Communication hook-up fees for the CM will be paid for by General Contractor.
4. Each Prime Contractor shall pay for their communication usage.

1.6 SUBMITTALS

A. Temporary Utilities: Prime Contractor shall submit reports of tests, inspections, meter readings and similar procedures performed on temporary utilities.

B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

D. Temporary Utility Reports: Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.

E. Shop Drawings and samples for verification: For temporary project identification sign, include the following information:
1. Sign design and details of construction.
2. Include dimensioned scale drawing indicating locations of text and size and location of graphic elements.
3. Font styles to be used, full size examples.
4. Color samples for each sign color indicated, not less than 3 inches square.

F. Moisture- Mold-Protection Plan: Each Prime Contractor shall describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

G. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:

1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
4. Waste-handling procedures.
5. Other dust-control measures.

H. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by Owner. Include the following:

1. Methods used to meet the goals and requirements of Owner.
2. Concrete cutting method(s) to be used.
3. Location of construction devices on the site.
4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with Owner.
6. Indicate locations of sensitive equipment areas or other areas requiring special attention as identified by Owner. Indicate means for complying with Owner's requirements.

1.7 QUALITY ASSURANCE

A. Regulations: Prime contractor shall comply with industry standards and with applicable laws and regulations of authorities having jurisdiction including, but not limited to, the following:
1. Building code requirements.
2. Health and safety regulations.
3. Utility company regulations.
4. Police, fire department and rescue squad rules.
5. Environmental protection regulations.

B. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.

1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.
2. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
3. Accessible Temporary Egress: Comply with applicable provisions in the DOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

C. Temporary Heat and Dehumidifying Equipment Supplier Qualifications: Engage a supplier experienced in supplying temporary heating and humidifying equipment and with the engineering and testing capabilities to recommend equipment sizes, predict fuel loads, predict humidity levels and test indoor air quality.

D. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.8 PROJECT CONDITIONS AND OPERATION

A. Temporary Utilities: At earliest feasible time, when acceptable to Owner, change over from use of temporary service to use of permanent service.

1. Temporary Use of Permanent Facilities: Installer of each permanent system and service shall assume responsibility for operation, maintenance, and protection of each permanent system and service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

B. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:

1. Keep temporary services and facilities clean and neat.
2. Relocate temporary services and facilities as required by progress of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Undamaged, previously used materials in serviceable condition may be used if approved by Construction Manager. Provide materials suitable for use intended.

B. Provide materials suitable for use intended.

C. Portable Chain-Link Fencing: The General Contractor shall provide temporary, post-driven galvanized steel chain link fence, 6'-0" high, 11-gauge wire in a 2" (50-mm) mesh with top and bottom selvages knuckled with movable supported ballast systems. At select locations where approved by CM, provide driven posts.

D. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain-link fence, sized to height of fence, in color selected by Architect from manufacturer's standard colors.

E. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less. For temporary enclosures, provide translucent, nylon-reinforced, laminated polyethylene or polyvinyl chloride, fire-retardant tarpaulins.

F. Water: Potable.

G. Pavement and Concrete: Comply with requirements of Division 03 and 32 Sections.

H. Lumber and Plywood: Comply with requirements of Division 06 Section "Rough Carpentry".

I. Gypsum Wallboard: Provide gypsum wallboard on interior walls of temporary offices.

J. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum 36 by 60 inches (914 by 1524 mm).

K. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively.

L. Roofing Materials: Provide UL Class A standard-weight asphalt shingles of UL Class C mineral-surfaced roll roofing on roofs of job-built temporary offices, shops and sheds.

M. Paint: Comply with requirements in Division 09 Section "Painting".
1. For job-built temporary offices, shops, sheds, fences, and other exposed lumber and plywood, provide exterior-grade acrylic-latex emulsion over exterior primer.
2. For sign panels and applied graphics, provide exterior-grade alkyd gloss enamel over exterior primer.
3. For interior walls of temporary offices, provide 2 coats interior latex-flat wall paint.

N. Open-Mesh Fencing: Provide 0.12-inch- (3-mm-) thick, galvanized 2-inch (50-mm) chain-link fabric fencing 6 feet (2 m) high galvanized steel pipe posts, 1-1/2 inches (38 mm) I.D. for line posts and 2-1/2 inches (64 mm) I.D. for corner posts.

2.2 TEMPORARY FACILITIES

A. Field Offices:

1. Mobile units with lockable entrances, operable windows, and serviceable finishes; heated and air-conditioned; on foundations adequate for normal loading.
2. Common-Use Field Office To accommodate needs of Owner, Architect, Construction Manager, and construction personnel office activities, and to accommodate Project meetings specified in other Division 01 Sections. The Contractor for General Construction shall provide, within one month of Notice to Proceed, a new or like-new insulated, weather-tight, prefabricated or mobile office units or similar job-built construction with lockable entrances, operable windows and serviceable finishes. Provide units with windows and lockable door on foundations adequate for office loading. Space shall include a 12' x 60' trailer with the following:
   a. Heating and cooling equipment appropriately sized for the space and capable of maintaining maintain a uniform indoor temperature of 68 to 72 deg F (20 to 22 deg C).
   b. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
   c. Two offices furnished with drawing table, work desk with storage drawers and rolling office chair, two (2) four-drawer filing cabinets and drawing rack.
   d. A room not less than 400 sq. ft. for project meetings furnished with a conference table, 15 folding chairs, 4-foot square tackboards and marker boards. This room will be dedicated for CM use and Project Meetings only.
   e. Keep office clean and orderly.

B. Field Office Relocation During Construction: Due to site constraints and construction activities, the field offices must be relocated during construction. Refer to the Construction Phasing Plan. The Contractor for General Construction shall relocate the units. The Electrical Contractor will relocate the electrical service for the units. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. General: The Prime Contractor shall provide new equipment. If acceptable to the Architect, undamaged, previously used equipment in serviceable condition may be used. Provide equipment suitable for use intended.

B. Water Hoses: Provide 3/4-inch (19-mm) heavy-duty, abrasion-resistant, flexible rubber hoses 100 feet (30 m) long, with pressure rating greater than the maximum pressure of the water distribution system. Provide adjustable shutoff nozzles at hose discharge.

C. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.

1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
2. Extinguisher shall have a valid inspection tag.

D. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

E. Drinking-Water Fixtures: Containerized, tap-dispenser, bottled-water drinking-water units with both hot and cold water, including paper cup supply.

F. Temporary HVAC Equipment: Unless Owner authorizes use of permanent heating system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction and marked for intended location and application.
3. Temporary Dehumidifying Equipment: Provide system engineered by temporary equipment supplier for expected conditions and interior environment requirements specified. Provide self-contained, recirculating refrigeration units with water collection and filtration capabilities.
   a. Equipment shall be sized with sufficient moisture extraction capabilities to maintain ambient interior air within specified relative humidity range.
   b. Provide collection and/or drainage capabilities to prevent condensate from re-evaporating in conditioned space or from spilling on floors.
4. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of thirteen (13) at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 01 77 00 "Closeout Procedures."

G. Generators: Provide generators sized to power equipment where temporary electric service is of insufficient capacity.

H. Electrical Power Cords: Provide grounded extension cords. Use hard-service cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ration.

I. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages of tempered-glass enclosures, where exposed to breakage. Provide exterior fixtures where exposed to moisture.

J. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.

K. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

L. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

M. Field Offices: Mobile units sized and equipped at the discretion of the Contractor. Units shall be kept clean, orderly and in good services.
1. Contractor shall equip and maintain its own field office with the following:
   a. Telephone service with automated answering capabilities. Superintendents cellular phone service may serve this purpose.
   b. Internal electrical distribution system terminating at an exterior mounted weatherproof heavy duty NEMA 3R disconnect.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials.

3.2 INSTALLATION, GENERAL

A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

B. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

C. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION AND REQUIREMENTS

A. General: Engage appropriate local utility company to install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
2. Provide adequate capacity at each stage of construction. Before temporary utility is available, provide trucked-in services.
3. Obtain easements to bring temporary utilities to Project site where Owner's easements cannot be used for that purpose.

B. Sewers and Drainage by General Contractor: If sewers are available, provide temporary connections to remove effluent that can be discharged lawfully. If sewers are not available or cannot be used, provide drainage ditches, dry wells, stabilization ponds, and similar facilities. If neither sewers nor drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off-site in a lawful manner.

1. Filter out excessive soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.
2. Connect temporary sewers to municipal system as directed by sewer department officials.
3. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. After heavy use, restore normal conditions promptly.
4. Provide temporary filter beds, settlement tanks, separators, and similar devices to purify effluent to levels acceptable to authorities having jurisdiction.

C. Water Service:

1. General: Install water service and distribution piping in sizes and pressures adequate for construction.
2. Temporary water service may be used by all entities engaged in construction activities at the Project Site.
3. General Contractor is responsible for all water needs on Project using water trucks until new water service is available at the building.
4. After new water service is available at the building, Plumbing Contractor shall provide the following:

a. Water Service: Use of Owner's new water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to like-new condition.
b. Provide rubber hoses as necessary to serve Project site.

c. As soon as water is required at each level, extend service to form a temporary water- and fire-protection standpipe. Provide distribution piping. Space outlets so water can be reached with a 100-foot (30-m) hose. Provide one hose at each outlet.
d. Where installations below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize water damage. Drain accumulated water promptly from pans.
e. Provide a minimum of 30-psi (200-kPa) static pressure at highest point.

D. Sanitary Facilities and Drinking Water by General Contractor: Provide temporary toilets, hand/wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.

1. Drinking Water: Install water service and distribution piping in sizes and pressures adequate for construction until permanent water service is in use. Sterilize temporary water piping before use.
2. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, hand sanitizer, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
3. Toilets: Use of Owner's existing toilet or new facilities will not be permitted.. Install self-contained toilet units. Shield toilets to ensure privacy. Contractor shall comply with the requirements of Section 008200, Safety and Health Plan Project Requirements, Article 13.0, Infectious/Communicable Disease Plan (ICDP), Common Practices, Paragraph C for temporary toilet facility requirements.
4. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material handled.
5. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.

E. Chain Link Fence:

1. The General Contractor shall secure the site and furnish gates as shown on Phasing Plan(s) or as required for project and directed by Construction Manager. The fencing and gates shall be relocated and adjusted during the Project as required, as noted on the Phasing Plans(s) and/or as directed by Construction Manager.
2. Temporary fence between the existing and operating building site and the construction area is to be installed as indicated on the Phasing Plans(s).

F. Temporary HVAC: The General Contractor shall provide temporary HVAC and humidity control required by construction activities, for curing or drying of completed installations, or protection of installed construction from adverse effects of low temperatures or high humidity from Notice to Proceed to NINETY (90) days prior to Substantial Completion for each new and renovation building area. Temporary HVAC and humidity control shall also be provided in all new building areas scheduled for work in order to maintain productivity of all trade contractors and personnel. Comply with the following:

1. Prior to enclosure of structure, structures or portions thereof, and when official local weather predictions indicate below freezing temperatures, the General Construction Contractor shall provide, maintain, operate and pay all costs including fuel to supply temporary heat where these utilities are determined to be necessary for the protection of the work and/or the construction activity as determined by the Construction Manager.
2. Temporary heat will be required on a 24-hour basis when the ambient temperature is predicted or is actually at 35 deg. F or lower.
3. Select safe equipment that will not have a harmful effect on completed installations or elements being installed.
4. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.
5. Maintain the temporary heat to a minimum of 60 degrees F. Each Prime Contractor is responsible for proving supplemental heat above 60 degrees F. for activities that require greater temperatures.
6. The General Contractor shall provide all other Prime Contractors with the Project Schedule and the minimum heating requirements to protect the Work as scheduled. If through no fault of any other Prime Contractor, the General Contractor does not maintain the original approved schedule, the General Contractor shall continue to provide temporary heat and humidity control to other Prime Contractors when required.

7. The General Contractor shall not be responsible for providing temporary heat and humidity control in permanently unconditioned areas or in areas not scheduled for work, unless the approved schedule is modified and accepted by the Owner and all Prime Contractors.
8. Prime Contractors are responsible for protecting their work in unconditioned or unscheduled work areas at no additional expense to the Owner.
9. Prior to the permanent heating system being operational, and when necessary for the proper prosecution of the work, the General Contractor shall provide, maintain, operate and pay all costs including fuel, for sufficient approved heat.
10. Comply with requirements of items specified in Divisions 03 through 14 for individual requirements associated with the work of these sections regarding the provision and maintenance of temporary heat, ventilation, cooling and humidity control necessary prior to and subsequent to installation.
11. Obtain requirements from sub-contractor with regard to the provision of temporary heat, ventilation, cooling and humidity control for the installation and protection of their work and submit report to Construction Manager and Architect regarding provision of temporary heat, ventilation, cooling and humidity control and requirements of the Construction Manager approved Construction Schedule.
12. Cooperate with other sub-contractors with regard to the provision of temporary heat, ventilation, cooling and humidity control required for the installation and protection of their work.
13. Coordinate with the General Contractor regarding the construction schedule to assure provision of required heating, ventilation, cooling and humidity control as needed for the progress of the construction.
14. Do not hinder scheduled construction activities, which require specific environmental control. The Contractor shall bear the costs for delays resulting from the failure to provide adequate temporary heat, ventilation, cooling and humidity control as required by the Architect approved construction schedule.
15. If the contractor provides temp heat with LP gas heaters, a full and complete plan of installation must be provided and approved by the local Fire Marshall and other authorities having jurisdiction at least one month prior to the date system is needed to go on line. Heating plan will comply with all codes for installation and operation. The contractor will be responsible to provide all standby personnel during the installation and operation the system. This includes trades from other jurisdictions if applicable. The contractor will be responsible for dismantling and removal (off site) of the system in entirety.
16. It is the intent of the temporary heating, air conditioning and humidity control systems to condition the construction space (area) to receive all flooring and other specialty construction materials that require specific temperature, humidity conditions or pH levels, prior, during or after the installation of the item. Refer to Divisions 03 – 14 and 31-33 for project condition requirements.
17. The responsibility of the provision of temporary heat subsequent to the enclosures of the building, buildings, or portions thereof shall be within the contract price, the total cost of which must be included and made a part of the lump sum bid submitted by each General Construction.

G. Temporary/Existing/Permanent HVAC: The HVAC contractor shall provide HVAC from NINETY (90) days prior to Substantial Completion of <u>each new and renovation building area and at all times for all building areas that are occupied or under construction</u> and shall comply with the following:

1. When noted above, the HVAC contractor shall provide, maintain and operate sufficient temporary heating/cooling. If the new permanent heating or cooling system is used during this period, the HVAC contractor shall professionally clean all HVAC systems.
2. The HVAC Contractor shall properly protect all HVAC equipment / systems from construction air dust and debris beginning from initial installation.
3. Select safe equipment that will not have a harmful effect on completed installations or elements being installed.
4. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.
5. Maintain the temporary heat to a minimum of 60 degrees F for construction areas and at 70 degrees F for all occupied areas.
6. At NINETY (90) days prior to Substantial Completion of new building areas, the Owner shall pay for fuel and electric energy used to operate the approved temporary or permanent heating or cooling and exhaust system provided that due care is exercised to avoid excessive use of fuel.
7. Portable heaters will not be acceptable during final finishing operations.
8. The new permanent heating and exhaust system or any portion thereof may be used by the HVAC Contractor to provide temporary heat and exhaust as required for the proper prosecution of the work as long as all the necessary protection and cleanup required by the Specifications and recommended by the manufacturer are strictly followed, and only when outside air is supplied directly to the burners.

The HVAC Contractor shall, when operating the permanent system complete all required servicing and adjusting to maintain the system in proper running order to prevent damage to the building or its equipment during the construction period. Units placed in permanent operation must be fully controlled using the final control system operational sequence.

9. When the HVAC Contractor performs startup and begins using the permanent HVAC systems, the Contractor must provide pre-filters, return air filters, plenum filters and or other modifications to the systems necessary to prevent dirt, dust and other contaminants from entering the system. If measures implemented do not prevent dust from entering the systems, the HVAC Contractor shall perform cleaning of duct, coil and other HVAC components necessary to provide clean HVAC systems at Substantial Completion of the Project.
10. Prior to turning over the new permanent heating and ventilating system to the Owner, the HVAC Contractor shall thoroughly clean the system, provide new filters, make re-adjustments as required and bear all cost to place the system in first-class operating condition. Contractor shall follow all requirements for cleaning and media as provided in Section 018119, Indoor Air Quality Management.
11. The warranty period of individual pieces of equipment of the permanent system used during the construction period shall be extended during the temporary use period and the starting date used for determination of expiration for such warranties shall begin upon final acceptance of the project by the Owner.
12. Work which is damaged as a result of improper or insufficient climate control shall be removed and replaced.

H. Ventilation and Humidity Control by General Contractor:

1. Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

2. Temporary Humidity Control:
   a. General: Where control of ambient humidity is required for proper performance of the work, or for curing/drying of installed work, or for protection of installed work from deterioration due to variations in ambient conditions and/or adverse effects of high humidity, the General Contractor shall provide temporary humidification or dehumidification equipment to maintain the required conditions. This equipment may require air conditioning to achieve the desired results and maintain the Project schedule. Determination of the required equipment is the responsibility of the General Contractor. Coordinate the use of the equipment with temporary heating to produce the required conditions with a minimum overall use of energy.
      Construction Dehumidification (ongoing): The General Contractor shall provide portable dehumidification units for use during construction. Units shall be provided as required to maintain optimal building moisture conditions required for the proper performance of the Work. Moisture levels shall be maintained throughout both occupied and unoccupied areas of the facilities.
   b. Units shall be refrigeration-based and shall include standard 115V power cord, humidistat, integral condensate pump, wheels and handle. Units shall be as manufactured by Ebac or approved equal. Dehumidifier capacities and quantities shall be as follows:

      i. Quantity 15 - Minimum 25 gallons/day capacity (Ebac BD150CR or equal).
      ii. Locations shall be as agreed upon in the field with the Architect and Construction Manager.

   c. General Contractor shall furnish and install drainage hoses and connections to discharge condensate to exterior of building at locations acceptable to the Construction Manager and Architect.
   d. The Electrical Contractor shall be responsible to distribute power sources throughout each area of the building dedicated for the purpose of power for the humidification and/or dehumidification units. This power shall be in addition to power required by the trades for performance of their Work.

I. Electric Power Service by Electrical Contractor: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnecting means, and automatic ground-fault interrupters. Connect temporary service as directed by electric company officials.

1. Install power distribution wiring overhead or underground and rise vertically where least exposed to damage.
2. Electric power service including all necessary poles and accessories shall be extended from off-site available sources after coordination with local electric utility company. Secure Construction Manager's approval of overhead service prior to installation.
3. Power provided shall be sufficient to allow all contracts to work without interruption due to issues with electrical service and quality of power provided.
4. Provide adequate temporary electric service and for the following temporary field offices for light, power, heating and cooling located on the site:

   1 – General Contractor
   1 – Construction Manager*
   1 – HVAC Contractor
   1 – Plumbing Contractor
   1 – Electrical Contractor

   **Field office for Owner's testing agents: Testing personnel will share Construction Manager's trailer provided by General Contractor.*

5. Provide or extend the following temporary construction electric services to the various building areas within forty (40) days of Notice to Proceed unless noted otherwise:

   a. 120/208-volt, three phase, four-wire wye with a solid neutral service.
   b. Transformation and power distribution as shown as required for temporary needs specified unless noted otherwise on Construction Documents.
   c. Power receptacles distributed across the building as the Project develops. Minimum requirements for each building as follows:
      - Twenty-five (25) 120-volt receptacles
      - Twenty (20) 240-volt receptacles
   d. Temporary power for trailers and construction area.
   e. Ten (10) temporary connections to HVAC temporary heating units when directed by CM.
   f. Five (5) site lights when directed by CM (see Article L below).

6. All extensions from the temporary power receptacles shall be provided by the parties requiring power.

J. Electric Power Service: Use of Owner's new electric power service will be permitted, as long as equipment is maintained in a condition acceptable to Owner.

K. Electric Distribution by Electrical Contractor: Provide receptacle outlets adequate for connection of power tools and equipment in new and existing building areas.

1. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
2. Provide warning signs at power outlets other than 110 to 120 V.
3. Provide metal conduit, tubing, or metallic cable for wiring exposed to possible damage. Provide rigid steel conduits for wiring exposed on grades, floors, decks, or other traffic areas.
4. Provide metal conduit enclosures or boxes for wiring devices.
5. Provide 4-gang outlets, spaced so 100-foot (30-m) extension cord can reach each area for power hand tools and task lighting. Provide a separate 125-V ac, 20-A circuit for each outlet.
6. At earliest feasible time, but no later than 60 days prior to Substantial Completion of each Phase, provide permanent electric distribution systems.
7. Provide 150A, 208V, 3-phase power distribution for temporary connections of terrazzo grinders during floor terrazzo installation. Provide power distribution at multiple locations as required to ensure the grinders can cover the entire terrazzo floor area using a 100' cord. Power distribution may

be provided from temporary source or permanent power distribution where available. Remove all temporary power distribution when it is no longer required.

L. Lighting by Electrical Contractor: Provide and maintain temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions. Wherever overhead floor or roof deck has been installed, the Electrical Contractor shall provide temporary lighting with local switching.

1. For new construction and existing buildings where all systems are removed:

a. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
b. Provide LED temporary lighting. Unless noted otherwise, each “lamp” shall be a minimum of 1600 lumens, either screw-in type or native LED type Where higher lumens are specified, lighting shall be native LED, not screw-in type. Lamps shall be uniformly distributed in all areas requiring temporary lighting to meet the minimum illumination intensity noted for the area or operation as outlined by the Occupational Safety and Health Administration (OSHA) standard for minimum illumination requirements at construction sites (OSHA 29 CFR 1926.56).
c. Install exterior-yard site lighting that will provide adequate illumination for construction operations, security, traffic conditions, and signage visibility when the Work is being performed.
d. Provide fifteen (15) pole-mounted (20 ft. high, minimum 10,000 lumens) temporary security lights controlled by a photocell to be installed as directed by CM.
e. At earliest feasible time, but no later than 60 days prior to Substantial Completion of each Phase, provide permanent lighting systems both inside the building and on the site for use in completing construction and lighting the project site. Contractor must operate, maintain and protect the permanent systems through final completion of the project and provide full project warranty from the contract completion date of the project.
f. The Contractor is further responsible for any additional lighting in excess of above if needed to perform the work properly.

M. Internet service by Electrical Contractor: Provide (1) Hotspot capable of 5G service for CM’s use only at the Project site. EC shall be responsible to pay for the Hotspot monthly service fee from Notice to Proceed through Final Completion.

N. EC shall also provide internet service/power to site monitoring camera and video storage system as specified and required by CM.

O. For existing construction: Maintain all existing HVAC, electrical fire safety, communications, and lighting systems in operation at all times until new systems are in place and operational. Do not interrupt service unless areas are not occupied in accordance with the schedule. Where all existing systems are removed for new installations, provide, at minimum, temporary systems as noted above for new construction areas. At earliest feasible time but no later than 60 days prior to Substantial Completion of each phase provide permanent systems. Contractors must operate, maintain and protect the permanent systems through final completion of the project and provide full project warranty from the contract completion date of the project.

3.4 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
2. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines in accordance with ASTM E136. Comply with NFPA 241.
3. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will not be permitted to use permanent facilities.

B. Temporary Signs: Refer to Site Phasing and Logistics Drawings. .

C. Temporary Site Lighting: Install exterior yard and sign lights so signs are visible when Work is being performed.

D. Temporary Roads and Paved Areas by General Contractor: Construct and maintain temporary roads and paved areas adequate to support loads and to withstand exposure to traffic during construction period. Locate temporary roads and paved areas in same location as permanent roads and paved areas and in compliance with the Phasing Plan(s). Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 312000 "Earth Moving."
3. Recondition base after temporary use, including removing contaminated material, regrading, proof rolling, compacting, and testing.
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Division 32 Section “Hot-Mix Asphalt Paving”.
5. Provide dust-control treatment that is non-polluting and non-tracking. Re-apply treatment as required to minimize dust.
6. Cooperate with Work by others on the adjoining property construction.

E. Storage and Staging: Use designated areas of Project site for storage and staging needs.

F. Dewatering Facilities and Drains: Comply with requirements in applicable Division 31 Sections for temporary drainage and dewatering facilities and operations not directly associated with construction activities included in individual Sections. Where feasible, use same facilities. Maintain Project site, excavations, and all construction areas free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining property nor endanger permanent Work or temporary facilities is <u>by General Contractor.</u>
2. Before connection and operation of permanent drainage piping system, provide temporary drainage where roofing or similar waterproof deck construction is completed is <u>by Plumbing Contractor</u>.
3. Prime Contractor installing drains and any pipes for storm or sanitary systems shall verify that all systems are clear of debris prior to Substantial Completion. If necessary, flush all systems.
4. Remove snow and ice as required to minimize accumulations is <u>by General Contractor</u>.
5. Remove water from trenches, excavations or other work of each contract <u>by individual Prime Contractors</u>.
6. Comply with regulations and responsibilities defined by the Erosion and Sedimentation Pollution Control permit. Fines associated with violations of permit shall be paid by the Contractor, and shall be at no cost to Owner.

G. Waste Disposal Facilities and Cleanup: General Contractor will provide waste-collection containers in sizes adequate to handle regular waste generated from construction operations. Each Prime Contractor is responsible for collecting, and disposing of, their respective construction waste generated from new building construction, existing building demolition and all site work operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste and dispose of this waste.

1. Each Prime Contractor shall perform waste collection and disposal on a daily basis for all site and building areas.
2. Contractor shall clean up all work areas on a daily basis including all site and building Contractor shall also segregate materials and place them in designated containers.
3. General Contractor shall be responsible for daily cleanup of all areas of the building unless noted otherwise below. HVAC contractor shall be responsible for daily cleanup of all mechanical and electrical rooms. All contractors shall be responsible for daily cleanup of the areas in which they are working.
4. Owner, after consultation with the Construction Manager, shall deduct $200.00 per day from each contractor that is not performing the required daily cleanup. The total amount will be deducted from the contractor’s total contract sum. Construction Manager will re-assign cleanup or hire independent contractor to perform cleanup. Construction Manager may also withhold processing of payment request until cleanup duties are resumed to Construction Manager’s satisfaction.
5. Each Contractor is responsible for removal of their respective waste from Work associated with its Contract and shall follow procedures to direct as much waste as possible from the landfill.

6. General Contractor shall coordinate the locations of the waste containers with Prime Contractors and as noted on Phasing Plan(s). All locations to be confirmed with the Construction Manager prior to placement.
7. General Contractor shall:

    i. Provide equipment and labor required for positioning and relocating waste containers on site as well as compacting or consolidating materials in the containers.
    ii. Provide equipment and labor required for lifting and hoisting any material handling units of 2.5 cubic yards, 1,000 lbs. (48” x 40”) into the building areas from waste management trucks and also back out onto trucks when boxes are full.
8. GC’s waste hauler will remove all waste containers from the Project site.

H. Field Offices:

1. Locate facility where it will serve the project adequately and result in minimum interference with the performance of the work. Relocate and modify facilities as required. Furnish facility prior to start of work and remove facility at final completion of project. Provide all utilities to service facility, including electric service, lighting, and other facilities as required.

I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

J. Temporary Elevator Use:
1. Use of Owner's elevators will NOT be permitted.
    a. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work, so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.

K. Temporary Stairs by General Contractor: Until permanent stairs are available, provide temporary stairs where ladders are not adequate. Cover finished, permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of acceptance. At Substantial Completion, restore stairs to condition existing before initial use.

1. Provide protective coverings, barriers, devices, signs or other procedures to protect stairs and to maintain means of egress. If, despite such protection, stairs become damaged, restore damaged areas so no evidence remains of correction work.

L. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

1. Provide protective coverings, barriers, devices, signs or other procedures to protect stairs and to maintain means of egress. If, despite such protection, stairs become damaged, restore damaged areas so no evidence remains of correction work.

M. Other Construction Aids: Provide construction aids and miscellaneous facilities, such as scaffolds, platforms, swing stages, ramps and bridges, incidental sheeting and shoring, and demolition waste chutes to suit project conditions.

N. Existing Elevator: Use of the existing elevator is not permitted.

O. Traffic Controls by General Contractor: Provide temporary traffic controls at junction of temporary roads with public roads. Include warning signs for public traffic and "STOP" signs for entrance onto public roads. Provide construction site signage on adjacent roads and site to direct public and construction traffic (both vehicular and pedestrian), comply with CM and Owner’s request for all site and road signage. Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain, including curbs, pavement, and utilities.

2. Maintain access for fire-fighting equipment and access to fire hydrants.

P. Temporary Signs by General Contractor:

1. Do not permit installation of unauthorized signs.
2. Refer to Site Phasing and Logistics Drawings.
3. Prepare and install up to 4 signs 4’ x 3’ with information to direct and control traffic on site and in building. Apply graphics and text as directed by Construction Manager. Install where directed.
4. Engage an experienced sign painter to apply graphics for Project identification signs. Comply with details provided by the Architect.
5. Construct signs of exterior-type Grade B-B high-density concrete form overlay plywood in sizes and thicknesses indicated. Support on posts or framing of preservative-treated wood or steel.
6. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer. Architect will provide digital file for graphic. Adhere custom vinyl graphic after paint has cured. Edge seal vinyl graphic using a fine-tip brush, painting the edges of the film with a commercial grade edge sealer.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near Project site. Comply with work restrictions specified in Section 01 10 00 "Summary.”

C. Stormwater Control: Provide silt barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of stormwater from heavy rains. Comply with requirements specified in Section 31 10 00 "Site Clearing.” Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, in accordance with erosion- and sedimentation-control Drawings.

D. Tree and Plant Protection: General Contractor shall install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from construction damage. Protect tree root systems from damage, flooding, and erosion.

E. Site Enclosure Fence: Before construction operations begin, install chain-link enclosure fence with lockable entrance gates. Locate where indicated or enclose entire Project site or portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering site except by entrance gates.

1. Set fence posts below grade a minimum of 3 feet.
2. Provide gate in sizes and at locations necessary to accommodate delivery vehicles and other construction operations.
3. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide CM and Owner with one set of keys and/or access code(s).
4. Provide plywood on fencing adjacent to existing windows and doors.

F. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft and similar violations of security. Lock entrances at end of each workday.

G. Site Security: Ensure all windows, doors and gates are closed and secured at the conclusion of each day in scheduled work areas.

H. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.

1. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8-inch thick exterior plywood.
2. Where indicated on phasing plan provide concrete 'Jersey' barriers.

I. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
2. Vertical Openings: Close openings of 25 sq. ft. or less with plywood or similar materials.
3. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
4. Closure assemblies shall prevent moisture penetration.
5. Install tarpaulins securely using fire-retardant-treated wood framing and other materials.
6. Where temporary wood or plywood enclosure exceeds 100 sq. ft. in area, use fire-retardant-treated material for framing and main sheathing.
7. Provide temporary enclosures as required to meet criteria for permanent enclosure no later than the beginning of any of the following Work:

    a. Spray fireproofing.
    b. Interior finishes, including gypsum wallboard finishing, painting and wall coverings.
    c. Architectural woodwork.
    d. Institutional casework.
    e. Install temporary enclosures before time frames stated above when necessary to maintain interior relative humidity levels and temperatures as required to promote drying of concrete and concrete masonry substrates so that they achieve low enough moisture content and vapor emission levels to permit timely installation of finishes.

J. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.

1. Construction dustproof partitions of not less than nominal 4-inch studs, 5/8-inch gypsum wallboard with joints taped on occupied side, and 1/2-inch fire retardant plywood on construction side.
2. Construct dustproof, floor-to-ceiling partitions of not less than nominal 4-inch studs, 2 layers of 3-mil polyethylene sheets, inside and outside temporary enclosure. Cover floor with 2 layers of 3-mil polyethylene sheets, extending sheets 18 inches up the side walls. Overlap and tape full length of joints. Cover floor with 3/4-inch fire-retardant plywood.
3. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
4. Protect air-handling equipment.
5. Weatherstrip openings.
6. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
7. Provide walk-off mats at each entrance through temporary partition.

K. Exterior Surface Protection:

1. Where sequence of operations exposes exterior finished materials including, but not limited to factory finished metal, anodized metal, glass and the like, to mortars, grouts, alkalis, acids, strong detergents or other materials that may cause damage to adjacent finishes, provide surface protection materials completely over surface to be protected.

2. Comply with surface protection material manufacturer's recommendations. Do not leave materials in place beyond maximum time limit.
3. Remove protection materials completely when at-risk work is complete.

L. Traffic Surface Protection:

1. New Finished Traffic Surfaces: From the time of installation to just before inspection for Substantial Completion, overlay traffic surfaces with traffic protection products as recommended by manufacturer for substrates to be protected. Replace traffic protection products when damaged. Where specified products do not meet construction traffic demands or when required by Architect or Construction Manager, provide more substantial protection as specified below for existing traffic surfaces to remain.
2. Existing Finished Traffic Surfaces to Remain: From the time of one week before the commencement of any work of a phase of any prime contractor in area or areas immediately adjacent to floors to be protected, overlay traffic surfaces with one layer of craft paper and follow with one layer of plywood. Secure plywood with heavy adhesive tape. Maintain protection for duration of work in area and remove just before inspection for Substantial Completion.

M. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

1. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
2. Develop and supervise an overall fire-prevention and first-aid fire-protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
3. Provide temporary standpipes and hoses for fire protection of sufficient length to reach construction areas. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.
4. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting.
5. Prohibit smoking and vaping in construction areas.
6. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
7. Coordinate activities with Fire Watch. Notify Fire Watch of hours of operation and planned fire-risk activities such as welding within construction areas.

N. Fire Watch: Provide adequate number of and properly trained personnel to provide fire watch in accordance with NFPA 51B "Standard for Fire Protection During Welding, Cutting and Other Hot Work 1999 Edition, NFPA 101 "Life Safety Code", Articles 9.6.1.8 and 9.7.6.1 (including appendix) and as follows:

1. Fire Watch personnel shall be trained and provide services in compliance with NFPA 601 "Standard for Security Services in Fire Loss Prevention" and shall be acceptable to the Authorities Having Jurisdiction.
2. The responsible party for Fire Watch Services as defined in Division 01 Section "Multiple Contracts Summary" shall be considered "Management" for the purposes of complying with the referenced standards.
3. Fire Watch personnel shall be provided with portable communications to permit immediate communication with school authorities, contractors and public emergency services.
4. Conduct a coordination meeting in advance of the earliest requirement for Fire Watch with the Owner, respective Project Coordinators, Construction Manager, Authorities Having Jurisdiction and Architect.

    a. Develop an emergency response plan for risks associated with construction. Coordinate with Owner's existing security and emergency response plan.
    b. Establish the lines of and order of communications based on each anticipated risk type.
    c. Project Coordinators shall record and transmit minutes of the meeting to attendees and to Fire Watch personnel.

5. Fire Watch shall be provided at the Work by respective responsible entity as defined in Division 01 Section “Multiple Contract Summary.”

    a. When hot work is being conducted.
    b. When fire alarm is not in operation in occupied areas for time greater than 4 hours.
    c. When fire suppression system is not in operation in occupied areas for time greater than 4 hours.

6. For the entire duration of time from the blocking of existing stair towers.
7. For the entire duration of time from the disturbance of the egress route.

N. Fire Extinguishers: Class A stored-pressure water-type extinguishers. Other Locations: Class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.

1. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.
2. Store combustible materials in containers in fire-safe locations.
3. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
4. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting.
5. Prohibit smoking/vaping on the Project site and within all building areas.
6. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.

O. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection in facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.

3.6 MOISTURE AND MOLD CONTROL

A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.

2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
   i. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
   ii. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Construction Manager.
   iii. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
2. Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

C. Temporary Facility Changeover for Security and Protection: Except for using permanent fire protection as soon as available, do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination, Removal and Temporary Facility Changeover: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are the property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns and dispose of in a legal manner. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Section 017700 "Closeout Procedures."
4. Replace significantly worn parts and parts that have been subject to unusual operating conditions.
5. Replace lamps that are burned out or noticeably dimmed by substantial hours of use.

3.8 NO SMOKING

A. Smoking , vaping, and/or use of any tobacco product is not permitted on the entire Project site.

3.9 IDENTIFICATION OR SIGNS

A. Individual contractor signs, other advertisements, or flags will not be permitted.

3.10 COMPLIANCE WITH TEMPORARY FACILITIES AND CONTROLS

A. If contractor does not comply with any of the requirements of this Section, CM reserves the right to recommend to Owner to withhold adequate funds from payment applications to pay for completing the Work as required.

END OF SECTION 01 50 00

SECTION 01 56 39 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes: General protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

B. Related Requirements:

1. Section 01 50 00 "Temporary Facilities and Controls" for temporary controls, utilities, support facilities, temporary site fencing, and, if applicable, temporary erosion and sedimentation controls if not specified in Section 31 10 00 "Site Clearing".
2. Section 31 10 00 "Site Clearing" for removing existing trees and shrubs and for temporary erosion- and sedimentation-control measures if not specified in Section 01 50 00 "Temporary Facilities and Controls".
3. Section 32 96 00 "Transplanting" for relocating existing trees and plants.

1.2 DEFINITIONS

A. Caliper: Diameter of a trunk measured by a diameter tape or the average of the smallest and largest diameters at a height 6 inches (150 mm) above the ground for trees up to and including 4-inch (100-mm) size at this height and as measured at a height of 12 inches (300 mm) above the ground for trees larger than 4-inch (100-mm) size.

B. Caliper (DBH): Diameter breast height; diameter of a trunk as measured by a diameter tape or the average of the smallest and largest diameters at a height 54 inches (1372 mm) above the ground line for trees with caliper of 8 inches (200 mm) or greater as measured at a height of 12 inches (300 mm) above the ground.

C. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

D. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings or defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.

E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:

a. Tree-service firm's personnel and equipment needed to make progress and avoid delays.
b. Arborist's responsibilities.
c. Quality-control program.
d. Coordination of Work and equipment movement with the locations of protection zones.
e. Trenching by hand or with air spade within protection zones.
f. Field quality control.

1.4 ACTION SUBMITTALS

A. Product Data:

1. General protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction

B. Shop Drawings:

1. Include plans, elevations, and sections showing trees and plants to be protected, locations of protection-zone fencing and signage, and the relationship between equipment-movement routes and material storage locations with protection zones.
2. Detail fabrication and assembly of protection-zone fencing and signage.

C. Samples: For each type of the following:

1. Organic Mulch: 1-pint (0.5-L) volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.

D. Tree-Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

1. Species and size of tree.
2. Location on site plan. Include unique identifier for each.
3. Reason for pruning.
4. Description of pruning to be performed.
5. Description of maintenance following pruning.

E. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

F. Mitigation Requirements: As required by jurisdiction or as developed by arborist, for mitigation of damage to trees and other plantings. Include the following:

1. Local ordinances governing tree mitigation.
2. Standards established under the approved tree mitigation report developed by the arborist.
3. "Digital Guide for Plant Appraisal" by Council of Tree and Landscape Appraisers.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For arborist and tree service firm.

B. Certification: From arborist, certifying that trees indicated to remain have been protected during construction in accordance with recognized standards and that trees were promptly and properly treated and repaired when damaged.

C. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

D. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

E. Quality-control program.

1.6 QUALITY ASSURANCE

A. Arborist Qualifications: Certified Arborist as certified by ISA

B. Tree-Service Firm Qualifications: An experienced tree-service firm that has successfully completed temporary tree- and plant-protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

C. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include dimensioned diagrams for placement of protection-zone fencing and signage, the arborist's and tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.

1.7 FIELD CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Moving or parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

D. Take precautions to protect plants from airborne contaminants, such as paint or fireproofing overspray.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill Soil: Stockpiled soil mixed with planting soil of suitable moisture content and granular texture for placing around tree; free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.

1. Mixture: Well-blended mix of 2 parts stockpiled soil to 1 part planting soil.
2. Planting Soil: Planting soil as specified.

B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:

1. Type: Shredded hardwood or Ground or shredded bark.
2. Size Range: 3 inches (76 mm) maximum, 1/2 inch (13 mm) minimum
3. Color: Natural.

C. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements: Previously used materials may be used when approved by Architect.

1. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and weighing a minimum of 0.4 lb/ft.; remaining flexible from minus 60 to plus 200 deg F; inert to most chemicals and acids; minimum tensile yield strength of 2000 psi and ultimate tensile strength of 2680 psi; secured with plastic bands or galvanized-steel or stainless steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than 96 inches apart.

    a. Height: 48 inches.
    b. Color: High-visibility orange, nonfading.

2. Gates or openings shall be provided for access through fencing surrounding protection zones.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

B. Prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

A. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Flag or Tie a 1-inch (25-mm) blue vinyl tape around each tree trunk at 54 inches (1372 mm) above the ground.

B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

3.3 TREE PROTECTION

A. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated. Do not exceed indicated thickness of mulch.
    1. Apply 4-inch uniform thickness of organic mulch unless otherwise indicated. Do not place mulch within 6 inches of tree trunks.
    2. Install temporary root-protection matting over mulch to the extent indicated.

3.4 PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from easily entering protected areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

    1. Plastic Fencing: Stretch fabric taut and secure to posts without bows or sags.

B. Maintain protection zones free of weeds and trash.

C. Maintain hydration of plants to assure plant survival.

D. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.

1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.5 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones in accordance with requirements in Section 31 20 00 "Earth Moving" unless otherwise indicated.

B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots.

3.6 ROOT PRUNING

A. Prune tree roots that are affected by temporary and permanent construction. Prune roots as indicated on Drawings and as follows:

1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
2. Cut Ends: Do not paint cut root ends.
3. Temporarily support and protect roots from damage until they are permanently covered with soil.
4. Cover exposed roots with burlap and water regularly.
5. Backfill as soon as possible in accordance with requirements in Section 31 20 00 "Earth Moving."

3.7 CROWN PRUNING

A. Prune branches that are affected by temporary and permanent construction. Prune branches [as indicated on Drawings, under direction of arborist] [as directed by arborist].

1. Prune to remove only injured, broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.
2. Do not remove or reduce living branches to compensate for root loss caused by damaging or cutting root system.
3. Pruning Standards: Prune trees in accordance with ANSI A300 (Part 1) [and as indicated on Drawings].

a. Type of Pruning: [Cleaning] [raising] [reducing] [and] [thinning] where indicated.
b. Specialty Pruning: [Structural] [restoration] [vista] [espalier] [pollarding] [palm] [and] [utility] where indicated.

B. Unless otherwise directed by arborist and acceptable to Architect, do not cut tree leaders.

C. Cut branches with sharp pruning instruments; do not break or chop.

D. Do not paint or apply sealants to wounds.

E. Provide subsequent maintenance pruning during Contract period as recommended by arborist.

F. Chip removed branches and dispose of off-site.

3.8 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.

1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.

C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

D. Minor Fill within Protection Zone: Where existing grade is 2 inches (50 mm) or less below elevation of finish grade, fill with backfill soil. Place backfill soil in a single uncompacted layer and hand grade to required finish elevations.

3.9 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.10 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours in accordance with arborist's written instructions.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Trees: Remove and replace trees indicated to remain that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

1. Small Trees: Provide new trees of same size and species as those being replaced for each tree that measures 4 inches or smaller in caliper size.
2. Large Trees: Provide one new tree(s) of 4-inch caliper size for each tree being replaced that measures more than 4 inches in caliper size.

a. Species: As selected by Architect

3. Plant and maintain new trees as specified in Section 32 93 00 "Plants."

END OF SECTION 01 56 39

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following administrative and procedural requirements: selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

B. Related Sections include the following:

1. Division 01 Section "Reference Standards and Definitions" specifies the applicability of industry standards to products specified.
2. Division 01 Section "Submittal Procedures" specifies requirements for submittal of the Prime Contractor's Construction Schedule and the Submittal Schedule.
3. Division 01 Section "Substitutions" specifies administrative procedures for handling requests for substitutions made after award of the Contract.

1.3 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through substitution process, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Bidder.

C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

E. Special Warranty: Written warranty required by or incorporated into the Contract Documents, to extend time limit provided either by manufacturer's warranty or to provide more rights for Owner.

F. Foreign Products," as distinguished from "domestic products," are items substantially manufactured (50 percent or more of value) outside the United States and its possessions. Products produced or supplied by entities substantially owned (more than 50 percent) by persons who are not citizens of, nor living within, the United States and its possessions are also considered to be foreign products.

G. "Materials" are products substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.

H. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections, such as wiring or piping.

1.4 SUBMITTALS

A. Product List: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.

1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
2. Form: Tabulate information for each product under the following column headings:

a. Specification Section number and title.
b. Generic name used in the Contract Documents.
c. Proprietary name, model number, and similar designations.
d. Manufacturer's name and address.
e. Supplier's name and address.
f. Installer's name and address.
g. Projected delivery date or time span of delivery period.
h. Identification of items that require early submittal approval for scheduled delivery date.

3. Initial Submittal: Within 30 days after date of commencement of the Work, submit (2) copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.

a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.

4. Completed List: Within 60 days after date of commencement of the Work, submit (3) copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.
5. Architect's Action: Architect will respond in writing to Contractor within 2 weeks of receipt of completed product list. Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Architect's response, or lack of response, does not constitute a waiver of requirement that products comply with the Contract Documents.

B. Pre-bid Substitution Requests: Submit one copy of each Pre-bid Substitution Request not later than 10 days prior to receipt of Bids for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Refer to Specification Section 00 2625, Substitution Request Form.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified material or product cannot be provided.
b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. List of similar installations for completed projects with project names and addresses and names and addresses of Architects and owners.
g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
j. Cost information, including a proposal of change, if any, in the Contract Sum.
k. Bidder’s certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

a. Form of Acceptance: Addendum.
b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated from the information provided it will be rejected.

C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each Contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect and Owner will determine which products shall be used.
3. The material selected by the Architect shall be provided at no additional cost to the Owner.

B. Source Limitations: To the fullest extent possible, provide products of the same kind from a single source.

1. When specified products are available only from sources that do not, or cannot, produce a quantity adequate to complete project requirements in a timely manner, consult with the Architect to determine the most important product qualities before proceeding. Qualities may include attributes, such as visual appearance, strength, durability, or compatibility. When a determination has been made, select products from sources producing products that possess these qualities, to the fullest extent possible.

C. Foreign Product Limitations: Except under one or more of the following conditions, provide domestic products, not foreign products, for inclusion in the Work:
1. No available domestic product complies with the Contract Documents.
2. Domestic products that comply with the Contract Documents are available only at prices or terms substantially higher than foreign products that comply with the Contract Documents.

D. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous.
Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily
accessible surface that is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:

1. Name of product and manufacturer.
2. Model and serial number.
3. Capacity.
4. Speed.
5. Ratings.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions. Deliveries addressed to the project, in general, the Owner, Architect/Engineer, or Construction Manager, will be refused and returned to shipper.

1. Notify Construction Manager and Owner 48 hours in advance of major deliveries.
2. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
3. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
4. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
5. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
6. Store products to allow for inspection and measurement of quantity or counting of units.
7. Store materials in a manner that will not endanger Project structure.
8. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
9. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
10. Protect stored products from damage.

B. Storage: Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Retain subparagraph above or below, or both, depending on what is specified in individual Specification Sections.

3. Specified Form: Forms are included with the Specifications. Prepare a written document using appropriate form properly executed.
4. Refer to Divisions 02 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures: Procedures for product selection include the following:

1. Product: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the product named.
2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements.
3. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that comply with requirements.
4. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Available Products: Where Specification paragraphs or subparagraphs titled "Available Products" introduce a list of names of both products and manufacturers, provide one of the products listed or another product that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
6. Available Manufacturers: Where Specification paragraphs or subparagraphs titled "Available Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed or another manufacturer that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
7. Product Options: Where Specification paragraphs titled "Product Options" indicate that size, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide either the specific product or system indicated or a comparable product or system by another manufacturer. Comply with provisions in "Product Substitutions" Article.
8. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Product(s)" are included and also introduce or refer to a list of manufacturers' names, provide either the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other

characteristics that are based on the product named. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.

9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product (and manufacturer) that complies with requirements and matches Architect's sample. Architect's and Owner’s decision will be final on whether a proposed product matches satisfactorily.

    a. If no product available within specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents on "substitutions" for selection of a matching product.

10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.

    a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect and Owner will select color, pattern, or texture from manufacturer's product line that does not include premium items.
    b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect and Owner will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COLOR SELECTION

A. Pre-Selected Colors:

1. Where colors have been specifically identified in the Contract Documents, the products provided by the Contractor shall match the selected color to the satisfaction of the Architect or the product will be rejected as non-conforming materials.
2. Manufacturers listed in the specification sections are capable of manufacturing the product specified but may not manufacture the specific selected color identified in the Contract Documents as part of their running line.

B. If additional up-charges are associated with providing the colors identified in the Contract Documents, the Contractor shall be responsible for all such costs and no additional cost to the Owner above the Contract Sum will be considered.

C. Colors Selected During Construction:

1. Products will be selected by the Architect from the standard colors of any of the listed or approved manufacturers, unless a specific color or color price range has been identified prior to bidding.

D. Location of Selected Colors: In general, preselected colors are identified in the following locations:

1. Exposed Interior Finishes: Room Finish Schedule - Color Legend.
2. Other Materials: Individual Specification Sections or notes to the Drawings.

2.3 SUBSTITUTIONS AFTER EXECUTION OF THE AGREEMENT

A. Substitution of Materials: No substitutions of materials will be considered after the Execution of the Contract without a Credit to the Owner unless a Product becomes unavailable through no fault of the Contractor.

B. NO ACTION TO REVIEW THE PROPOSED SUBSTITUTION WILL BE TAKEN BY THE ARCHITECT OR ENGINEER UNTIL THE CONTRACTOR HAS SUBMITTED THE FOLLOWING:

1. A letter itemizing the proposed credit to Owner.
2. A copy of the warranty.

3. A summary of the schedule impact.
4. Properly executed Document 002625, Substitution Request Form.

C. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request as included above, or when acceptance will require revision to the Contract Documents.

D. In submitting a substitution request the Contractor acknowledges that:

1. The Contractor shall coordinate installation of the substitution including modifications to other Work.
2. The use of this Substitution will not adversely affect the Project Schedule.
3. If modifications to the work of this contract or another contract are required because of the substitution these modifications shall be made at no additional cost to Owner.
4. The Contractor waives all rights to claims for additional costs or time extension which may subsequently become apparent.

2.4 COMPARABLE PRODUCTS

A. Where products or manufacturers are specified by name, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents, and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of Architects and Owners, if requested.
5. Samples, if requested.

2.5 USE OF NON-HAZARDOUS MATERIALS:

A. Materials used in this Project shall have no detectable levels of the following hazardous materials.

1. Asbestos of any form or type.
2. Lead in water supply line solder.
3. Lead in paint coatings and finishes.
4. Polychlorinated Biphenyls (PCBs).

B. Upon substantial completion, the Contractor shall submit, on its company letterhead, a signed statement certifying that the products supplied under its Contract had no detectable levels of the hazardous materials listed above in Paragraph 2.5.A. Final payment will not become due until five (5) copies of this letter are submitted (one each for the CM and Architect's files and three for Owner).

PART 3 - EXECUTION

A. Comply with manufacturers' instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.

B. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION 01 60 00

SECTION 01 71 23 - FIELD ENGINEERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes general procedural requirements governing execution of field engineering services including, but not limited to, the following:

1. Construction layout.
2. Field surveying and recording of all underground utilities and stormwater.
3. Registered site drawings.

B. All work specified in this Section shall be provided and paid for by the General Contractor (GC) as noted below:

1.3 SUBMITTALS

A. Qualification Data: For land surveyor to demonstrate their capabilities and experience, include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. Certified As-Built Underground Utilities Surveys: Submit two (2) copies signed, sealed, and dated by land surveyor. Certified surveys shall be provided on reproducible mylars and on electronic files in format as directed by the Architect and with Article 3.5.H.15.

C. Registered As-Built Site Drawing: Submit two (2) copies signed, sealed, and dated by registered surveyor within 14 days of Substantial Completion and certificate signed by the Land Surveyor that elevations and locations of Work are in conformance with the Contract Documents. Site drawings shall be provided on reproducible mylars and on electronic files in format as directed by the Architect and with Article 3.5.H.15.

1.4 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally licensed qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping, and underground electrical services.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
3. Information and data reflected in the Contract Documents with respect to Underground Facilities at or contiguous to the site is based upon information and data furnished to Owner and Architect by owners of such Underground Facilities or others. Owner, Construction Manager, and Architect do not assume responsibility for the accuracy or completeness thereof unless it is expressly provided otherwise in the General Conditions. Contractor shall verify the location of all underground utilities prior to any excavation.
4. GC is responsible, on behalf of the project facility owner, for providing the physical markings of all existing utilities including those on site as indicated on the drawings or that may be identified in the field. The locations shown on the drawings are approximate. The Contractor must include in his bid the cost for hand-dug test holes, or other means, to ascertain the precise position of such underground facilities on the site owned by the Owner. This verification should be performed for any utilities to be relocated, removed, modified, or that may otherwise interfere with planned work. The utilities in the public right of way will be identified and marked by the appropriate facility owner as per the requirements of the PA One Call Act as amended. Physical layout is to be performed in full compliance with the PA One Call PA Act 287 of 1974 as amended by Act 18 of 1996 and Act 50 of 2017.

3.2 CONSTRUCTION LAYOUT

A. General: The GC will be responsible to lay out building foundations and column grid locations.

B. Layout for GC: GC shall be responsible for layout and location of all work under the General Contract.

C. Layout for other Trades: GC shall locate on-site control points, elevation control, and reference points for use by MEP Trades to perform their own layout and work.

3.3 FIELD SURVEYING

A. Identification: Owner will identify existing benchmark and control point.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

3.4 UNDERGROUND UTILITIES SURVEY

A. The Land Surveyor shall record the location, inverts, etc. of all the following underground utilities, beyond the exterior face of the building:

1. Storm water: Include all inverts, top of rim or grate, pipe sizes, and locations.

2. Storm water structures: Include elevations of all top of grate, bottom of structures, and pipe sizes.
3. Underground drainage system: Include inverts, top of rim or grate, and locations.
4. Underground electric, telephone, cable television, manholes, power and control lines, spare conduits for future uses, computer conduits, etc. Provide locations and elevations.
5. Sanitary sewer system including all structures: Provide locations, inverts, top of rim or grate, and bottom of structures.
6. Water distribution system, electric, telephone, and cable television lines shall be located at 50-foot intervals and at changes in horizontal and vertical direction of line. Around turns, where the radius is less than 100 feet, the interval shall be 25 feet.
7. Natural gas system distribution piping, piping sizes, locations, and elevations.

B. The Land Surveyor shall coordinate obtaining all the above improvements information with the Contractor making the installation since trenches for utilities will be backfilled as soon as the lines are installed.

C. Contractor shall prepare all drawings necessary to record the specified information. Drawings shall indicate all property lines, new and existing structures, etc.

3.5 CONTROL POINTS

A. GC shall provide engineering and layout for its work. In addition, the GC shall provide and maintain throughout the Project all building corners and column centerlines. GC shall provide floor control lines for each floor consisting of at least two perpendicular column lines per area and finish floor elevations. Each Prime Contractor shall be responsible for other surveys, engineering, layouts, etc., required in connection with their own work. Each Prime Contractor, at its own expense, is to provide stakes, templates, and labor required in laying out its work as is responsible for proper execution of the Work in accord with lines, levels, elevation, and dimensions indicated in the Contract Documents.

B. Contractor shall be responsible for checking the position of the reference points comprising the primary control prior to starting site work and shall notify Engineer of discrepancies found between actual and record measurements.

C. The existing reference points shall not be disturbed without prior written approval from the Engineer. If existing reference points are disturbed during construction, new reference points shall be installed by the GC to control the work. The locations of the new reference points will be approved by the Engineer prior to setting the new reference points.

D. Protection of monuments and stakes is the responsibility of GC. Replacement of damaged control and reference points shall be at Contractor's expense.

E. From the primary reference control provided by Owner, establish secondary control points necessary for the layout and construction of the Work. Secondary control shall consist of sufficient permanent points to establish the lines and grades for the various Work either directly or by offset. Layout lines for use in construction of the Work shall be established by the Contractor and taken directly from either the primary or secondary controls.

F. Secondary control shall be tied to and closed upon the primary control.

G. ACCURACY OF LAND BASED SURVEYS

1. Points for cross sections shall be located to the nearest 0.05 foot horizontally and vertically.
2. Vertical elevation surveys shall close within 0.05-foot times the square root of the length of the circuit in miles.
3. All grade stakes shall be set to 0.02 foot.
4. Alignment of tangents and curves shall be within 0.01 foot.
5. Points for structures shall be set to the nearest 0.02 foot, except where operational function of special features require closer tolerances.
6. Survey movement monuments shall be surveyed within an accuracy of 0.91 foot vertical and 0.01 foot horizontal.
7. Tolerances for all other Work shall be as shown or specified in the Contract Documents.

8. Survey instruments shall be accurate and shall be subject to inspection by Engineer for proper operation.
9. Electronic distance measuring (EDM) instruments used by Contractor on the Site shall be checked for calibration a minimum of once per month on an established base line approved by Architect and CM. Calibration results shall be kept in a logbook, available for Architect and CM review, showing the date and distances measured on the base line. An EDM shall not be used if it does not meet the minimum advertised accuracy published by the manufacturer of the EDM.
10. Defective instruments shall be promptly replaced, repaired, or adjusted to operate within the tolerances of the instrument manufacturer.
11. All work not performed with the methods and equipment as submitted by Contractor and accepted by Architect and CM shall be removed and replaced by Contractor at its own expense.

H. GC shall submit an electronic copy and a signed, sealed, mylar copy of a registered site drawing(s) prepared by a registered surveyor within 14 days of Substantial Completion and certificate signed by the Land Surveyor that elevations and locations of Work are in conformance with the Contract Documents. Drawing(s) shall include, at a minimum:

1. Property lines with metes and bounds.
2. North arrow.
3. Dimensions (overall) of structures.
4. Location of structures in relation to property lines.
5. Location and dimension of setbacks, easements, and rights-of-way.
6. Location of structures, wooded areas, water courses, rock outcrops, culverts, and other significant physical features on the site.
7. Name of Owners of the adjoining properties. Provide information on adjoining properties as required by the Township/Borough Ordinance including, but not limited to, lot number, plat name, recording reference number, etc.
8. Utility data as follows:

    a. Location of utility lines and structures including, but not limited to, electricity, gas, water, sanitary, telephone, cable, and fiber cable.
    b. Location and identification of storm sanitary structures including, but not limited to, manholes, cleanouts, inlets, catch basins, yard drains, and endwalls. Include elevations at top and invert of each structure.
    c. Location, size, type, and invert of pipes flowing into and from each storm and sanitary structure.

9. Locations and trunk diameters of existing trees and tree masses located within the project site.
10. Topographic contours with two-foot intervals for overall site plan.
11. Driveway and parking areas, sidewalks, stairs, ball fields (indicating limits of infields), running tracks, bleachers, and other physical features (e.g. lighting standards, fencing, benches, paving types (concrete, bituminous, brick) curb types (concrete bituminous), etc.).
12. Elevations at perimeter of buildings, sidewalks, areaways, curbs, finish floor elevations at each entry of each building, and other site elements. Provide sufficient spot elevations to indicate drainage patterns and vertical elevation changes (e.g. stairs, loading docks, etc.). Provide floor elevations inside building.
13. Names, dimensions, and rights-of-way of adjoining streets at intersecting driveways and streets along and within 100 feet of the property frontage.
14. Utilize the same benchmark as the original survey which is included as part of the drawing set.
15. Final drawing survey to be submitted electronically in either DXF or AutoCAD DWG format.

END OF SECTION 01 71 23

SECTION 01 73 29 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Field verify existing conditions prior to proceeding with the work. Notify the Architect in writing of any conditions that are significantly different from those indicated on the drawings. Adjust work in accordance with the Architect's instructions.

B. This Section includes general administrative and procedural requirements governing execution of the Work.

C. Requirements and limitations for cutting and patching of Work.

1. A Contractor, subcontractor, or sub-subcontractor requiring the cutting of openings in new Work installed by others shall have such openings cut and patched by the trade which installed the work, and such cutting and patching shall be at the expense of the Contractor, subcontractor, or sub-subcontractor requiring the opening.
2. A Contractor, subcontractor, or sub-subcontractor requiring the cutting of openings or patching of existing materials shall be performed by a sub-contractor with experience in cutting and patching of material being modified and shall be at the expense of the Contractor, subcontractor, or sub-subcontractor requiring the opening.
3. Approval to do such cutting and patching shall be received from the Architect prior to proceeding with the work and shall include installation of such reinforcement of the work as the Architect may direct.
4. All blocking, bracing, reinforcement, or structural enhancement required due to cutting and patching shall be provided at no additional cost to Owner. All patching work shall match adjacent existing Work unless otherwise noted.
5. Contractor, subcontractors, and sub-sub-contractors shall conduct Work in accordance with the Occupational Safety and Health Act of 1970 (OSHA) and all additions, amendments, and revisions thereto.

D. Related Sections include the following:

1. Division 01 Section 017300 "Execution" for additional general administrative and procedural requirements governing execution of the Work.
2. Divisions 02 through 31 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

    a. Requirements in this Section apply to plumbing, mechanical, and electrical installations. Refer to Divisions 21 through 28 Sections for other requirements and limitations applicable to cutting and patching plumbing, mechanical, and electrical installations.

1.3 DEFINITIONS

A. Cutting: Removal of existing or in-place construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 PREINSTALLATION MEETINGS

A. Cutting and Patching Conferences: Prior to commencing Work requiring cutting and patching, meet at Project site with parties involved in cutting and patching to review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching Work. Inform Architect and Construction Manager of scheduled meeting. Require representatives of each Prime Contract directly concerned or affected by the cutting and patching to attend, including the following:

a. Contractor's superintendent.
b. Trade supervisor responsible for cutting operations.
c. Trade supervisor(s) responsible for patching of each type of substrate.
d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.

B. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
2. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
3. Products: List products to be used and firms or entities that will perform the Work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.

   a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and structural calculations showing integration of reinforcement with original structure.
7. Architect’s Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.6 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

1. Primary operational systems and equipment.
2. Fire separation assemblies.
3. Air or smoke barriers.
4. Fire-protection systems.
5. Plumbing piping systems.
6. Mechanical systems piping and ducts.
7. Control systems.
8. Communication systems.
9. Fire-detection and -alarm systems.
10. Conveying systems.
11. Electrical wiring systems.
12. Operating systems of special construction.

C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.

1. Water, moisture, or vapor barriers.
2. Membranes and flashings.
3. Exterior curtain-wall construction.
4. Sprayed fire-resistive material.
5. Equipment supports.
6. Piping, ductwork, vessels, and equipment.
7. Noise- and vibration-control elements and systems.

D. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.

    a. Processed concrete finishes.
    b. Match-veneer woodwork.
    c. Stonework and stone masonry.
    d. Ornamental metal.
    e. Preformed metal panels.
    f. Roofing.
    g. Firestopping.
    h. Window wall system.
    i. Stucco and ornamental plaster.
    j. Terrazzo.
    k. Carpeting.
    l. Finished wood flooring.
    m. Wall covering.
    n. HVAC enclosures, cabinets, or covers.

1.7 WARRANTY

A. Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void any warranties required or existing.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections of these Specifications.

B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials. Use materials that are not considered hazardous.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Before proceeding, meet at the Project Site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
2. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
3. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently, patch as required to restore surfaces to their original condition.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations. Cutting tools or saws shall be equipped with bays or containers, or connected to vacuum systems, to minimize dust.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering, and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. Finished Surfaces: To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as a carborundum saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

D. Each Prime Contractor shall do cutting and patching in existing work or work already constructed required for the work involved in their Contract. Patch holes or openings left by him to match the unaltered existing construction:

1. In Work already constructed, lintels and structural supports required to maintain structural integrity shall be provided by the Contractor whose work requires the opening.
2. Cutting of holes, installation of curbs, and temporary, weatherproof, and secured enclosures for penetrations through the existing Work shall be the responsibility of the Prime Contractor whose work requires the penetration. Actual roof flashing and associated work must be executed by a subcontractor, hired by the Prime Contractor, who is acceptable to the manufacturer of the existing roof which shall be certified, in writing, to the Owner and Architect/Engineer by the manufacturer. Existing warranty/guarantee shall be certified as remaining valid.
3. For penetrations through new work, the Prime Contractor whose work requires the penetration shall be responsible to provide the General Contractor of location, size, and configuration required for the penetration well in advance of the scheduled work. Prime Contractor who requires penetrations through the new roof construction shall provide the prefabricated roof curb and temporary, weatherproof, and secured enclosure on top of curb.

E. Each Prime Contractor shall employ skilled and experienced installer to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.

F. Each Prime Contractor shall submit written request in advance of cutting or altering elements affecting:

1. Structural integrity of element.
2. Integrity of weather-exposed or moisture-resistant elements.
3. Efficiency, maintenance, or safety of element.
4. Visual qualities of sight-exposed elements.
5. Work of Owner or separate contractor.

G. Should conditions of work or the schedule indicate a change of products from original installation, each Prime Contractor shall submit request for substitution as specified in Section 016000 “Product Requirements”.

1. Inspect existing conditions of project, including elements subject to damage or to movement during cutting and patching.
2. After uncovering work, inspect conditions affecting installation of products or performance of work.
3. Report unsatisfactory or questionable conditions to Construction Manager and Architect/Engineer, in writing; do not proceed with Work until Architect/Engineer has provided further instructions.

H. Each Prime Contractor shall submit written notice to Construction Manager designating the date and time the work will be uncovered.

1. Provide adequate temporary support as necessary to assure structural value or integrity of affected portion of work.
2. Provide devices and methods to protect other portions of project from damage.
3. Provide protection from elements for that portion of the project exposed by cutting and patching work and maintain excavations free from water.

I. Each Prime Contractor shall execute cutting, fitting, and patching including excavation and fill, to complete Work and to:

1. Make its several parts fit together properly.
2. Uncover portions of the work to provide for installation of ill-timed work.
3. Remove and replace defective work.
4. Remove and replace work not conforming to requirements of the Contract Documents.
5. Remove samples of installed work as specified for testing.
6. Provide routine penetrations of non-structural surfaces for installation of piping and electrical conduit.

J. Each Prime Contractor shall execute Work by avoiding damage to other work and providing proper surfaces to receive patching and finishing.

K. Each Prime Contractor shall execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances, and finishes.

L. Each Prime Contractor shall restore Work with new products in accord with requirements of Contract Documents.

M. Each Prime Contractor shall fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

N. Each Prime Contractor shall maintain integrity of wall, ceiling, or floor construction, and completely seal voids.

O. Each Prime Contractor shall refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.

P. Each Prime Contractor shall identify hazardous substance or condition exposed during the Work and report to the Construction Manager for decision or remedy.

3.4 HAZARDOUS MATERIAL PROVISIONS

A. Potential for Hazardous Materials that may affect the Work: Certain environmental conditions or hazardous materials may exist or be encountered during the Work. Each Prime Contractor shall follow the guidelines listed below for the environmental conditions listed that may exist or be encountered during the Work.

B. The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a hazardous material or substance, including but not limited to asbestos, mercury, or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner, Construction Manager, and Architect of the condition.

1. Lead-Based Paint: Painted and varnished surfaces in buildings built prior to 1978 must be assumed to be coated with lead-based paint. Contractors shall immediately report to Construction Manager any areas suspected to be lead paint for decision or remedy. Contractor shall be responsible for all costs related to removal of lead-based paint items in areas affected by their Work as noted below. All required testing shall be performed in accordance with applicable EPA and HUD standards and guidelines pertaining to lead-based paint inspections.

a. Lead-Based Paint Disturbance. Each Prime Contractor shall be responsible for lead-based paint disturbance precautions.

i. For buildings defined as a Child-Occupied Facility (children under the age of 6). When these surfaces are disturbed, that disturbance shall be conducted in accord with the Environmental Protection Agency (EPA) 40 CFR, Part 745 “Lead, Renovation, Repair and Painting Program”. Compliance is to include using EPA licenses and certified trained renovators, Owner and occupant notifications, work area containment, dust minimization, and clean-up certification. Architect/Engineer shall be copied on the Owner and occupant notifications.

ii. For buildings that are not defined as a Child-Occupied Facility (children under the age of 6), all renovation or new construction work that impacts painted components containing lead shall be performed in accordance with the OSHA Lead-in Construction Standard (29 CFR 1926.62), as applicable to the work being performed; and a proper waste management plan shall be utilized to certify that the waste is tested for hazardous waste classification, as applicable, and properly disposed or recycled. Contractors working on the project are responsible for fulfilling all applicable OSHA requirements pertaining to lead, as well as all other applicable federal, state, or local requirements or regulations pertaining to lead-in construction.

b. Lead-Based Paint: Demolition and Handling

i. Contractor shall handle, contain, store, test, transport, and dispose of demolition debris with lead-containing surface coating in accordance with applicable local, state, and federal regulations. Most painted architectural components in fair condition (not blistering, peeling, etc.), by law, may be disposed of as Construction and Demolition (C&D) debris. If deemed necessary for disposal, Contractor shall be responsible for collecting and having analyzed representative samples of the waste. If necessary, samples shall be tested for toxicity using the Toxicity Characteristics Leaching Procedure (TCLP) for lead sufficient to determine whether the debris is a hazardous waste as defined in 40 CFR 261.3, or a residual waste, as defined in 25 PA Code 287.1, and shall include such analysis as required by the disposal facility. A qualified environmental laboratory acceptable to the Architect and Construction Manager shall conduct tests. A copy of all testing shall be forwarded to the Architect, Construction Manager and Owner.

ii. The Contractor shall be responsible for the costs of sample collection and laboratory analysis. Alternately, Contractor can assume lead waste generated is a hazardous

waste and TCLP testing is not required, but the waste must then be disposed of and transported as hazardous waste.

iii. If, based on testing, there is any hazardous waste generated and transferred to a hazardous waste disposal facility, Contractor shall provide, within 45 days from the time the material is transferred to the disposal facility, a waste manifest to the Owner that identifies the disposal facility name and address, EPA Identification Number, the identity of the waste material, and a statement certifying that the waste was disposed at that facility, including the date. Forward original document to Owner with a copy to the Architect and Construction Manager.

2. Polychlorinated Biphenyl (PCB) Light Ballasts and Mercury-Containing Fluorescent Light Fixture Recycling and Disposal

a. PCB Light ballasts:

i. Ballasts demarcated as non-PCB containing may be recycled as non-PCB ballasts in accordance with applicable industry standards for those types of ballasts.

ii. Ballast that do not carry a demarcation of non-PCB should be assumed to contain PCB's and recycled as PCB ballasts in a facility that accepts PCB ballasts as universal waste unless they are electronic (no suspect oil). Leaking PCB light ballasts shall be disposed of as hazardous waste unless testing is performed to classify the waste for PCB's.

b. Fluorescent light tubes should be assumed to contain mercury at levels that could deem them "hazardous waste" for disposal purposes. All fluorescent light tubes impacted by renovation or new construction work shall be sent for recycling as universal waste to a facility that accepts mercury-containing light tubes as part of their universal waste program.

3.5 CLEANING

1. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar items. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

END OF SECTION 01 73 29

SECTION 01 77 00 – CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of each prime contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for Project closeout, including but not limited to:

1. Inspection procedures.
2. Warranties
3. Instruction of Owner's personnel
4. Project record document submittal.
5. Final cleaning.

B. Related Sections include the following

1. Divisions 02 through 33 Sections for specific closeout and special cleaning requirements for products of those Sections.
2. Division 01 Section 019113 "General Commissioning Requirements" for additional information and procedures.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following: List exceptions in the request.

1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion if claimed, show 100 percent completion for the portion of the Work claimed as substantially complete. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
    a. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.

2. Advise Owner of pending insurance change-over requirements.
3. Obtain and submit release enabling the Owner unrestricted use of the Work and access to services and utilities; include occupancy permits, operating certificates and similar releases.
4. Submit record drawings, damage or settlement survey, and similar final record information.
5. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
7. Complete startup testing of systems.
8. Submit test/adjust/balance records.
9. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
10. Complete final clean-up requirements.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect, Owner and Construction Manager will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, which must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. If a reinspection identifies work that remains uncompleted, the Contractor shall be responsible for the cost of additional inspections by the Architect and Construction Manager. The Architect and Construction Manager will submit a time and material invoice to the Owner, who will deduct the amount from the balance due to the contractor.
3. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL ACCEPTANCE

A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following: List exceptions in the request.

1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
2. Submit an update final statement, accounting for final additional changes to the Contract Sum.
3. Submit a certified copy of the Design Professional's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Design Professional.
4. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as the date of Substantial Completion, or when the Owner took possession of and responsibility for corresponding elements of the Work.
5. Submit consent of surety to final payment.
6. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
7. Submit a Contractors Affidavit of Release of Liens using AIA Document G706A.
8. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
9. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
10. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, the Architect, Owner and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect, Owner, and Construction Manager will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. If a reinspection identifies work that remains uncompleted, the Contractor shall be responsible for the cost of additional inspections by the Architect and Construction Manager. The Architect and Construction Manager will submit a time and material invoice to the Owner, who will deduct the amount from the balance due to the contractor.

1.5 RECORD DOCUMENT SUBMITTALS

A. General: Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Design Professional's reference during normal working hours.

B. Record of Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location of the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

1. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work
2. Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.
3. Note related Change Order numbers where applicable.
4. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.

C. Record Specifications: Maintain one complete copy of the Project Manual, including addenda, and one copy of other written construction documents such as Change Orders and modifications issued in printed form during construction. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation. Note related record drawing information and Product Data.

1. Upon completion of the Work, submit record Specifications to the Design Professional for the Owner's records.

D. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record-keeping and Submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to the Architect for the Owner's records.

1.6 CLOSEOUT DOCUMENTATION SCHEDULE

A. Contractor to submit all final closeout documentation within forty-five (45) days of Substantial Completion. If all closeout documentation is not provided within the allotted time, the Owner reserves their right to initiate a fee of $1,000 per day past the forty-five days after Substantial Completion, until such time all closeout documentation has been received, reviewed, and accepted.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Each prime Contractor is responsible for final cleaning of the work included in their contract. The General Contractor is responsible for overall coordination of the final cleaning. If any Contractor fails to provide final cleaning as specified herein, the Owner reserves the right to perform the final cleaning either with their own personnel or an outside agency. The cost of final cleaning if performed by the Owner or their representatives shall be deducted from the amount due to the contractor responsible. If the responsible contractor cannot be identified, the Owner will apportion the cost to each individual contractor, as necessary.

C. Cleaning: Employ experienced workers or professional cleaners for final cleaning.

1. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion.

    a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    g. Sweep concrete floors broom clean in unoccupied spaces.
    h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
    i. Clean and provide waxing for tile floors as indicated on the Construction Documents.
    j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
    k. Remove labels that are not permanent.
    l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
    m. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
    n. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
    o. Replace parts subject to unusual operating conditions.
    p. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
    q. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
    r. Clean ducts, blowers, and coils if units were operated without filters during construction.
    s. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
    t. Leave Project clean and ready for occupancy.

D. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.

E. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner.

F. Reestablishment of the Work Area

1. Reestablish local HVAC, mechanical and electrical systems in proper working order where needed.
2. Repair any damage that occurred as a result of demolition activities.

G. Project Close-Out

1. Within not more than twenty (20) days of the date of Substantial Completion and prior to the time that any final payment shall become due to the Prime Contractor, the Prime Contractor shall furnish to the Architect all certifications, test reports, disposal manifests and other documentation duly completed in accordance with the requirements of the Contract Documents and any applicable Federal, State or Local law.

END OF SECTION 01 77 00

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Maintenance manuals for the care and maintenance of products, materials, finishes systems and equipment.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Section 011250 "Multiple Contract Summary" for coordinating operation and maintenance manuals covering the Work of multiple contracts.
2. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
3. Section 017700 "Closeout Procedures" for submitting operation and maintenance manuals.
4. Section 017839 "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
5. Section 019113 “General Commissioning Requirements” for verification and compilation of data into operation and maintenance manuals.
6. Divisions 02 through 33 Sections for specific operation and maintenance manual requirements for products in those Sections.

C. DEFINITIONS

1. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

2. Subsystem: A portion of a system with characteristics similar to a system.

1.3 QUALITY ASSURANCE

A. Maintenance Manual Preparation: In preparation of maintenance manuals, use personnel thoroughly trained and experienced in operation and maintenance of equipment or system involved.

1. Where maintenance manuals require written instructions, use personnel skilled in technical writing where necessary for communication of essential data.
2. Where maintenance manuals require drawings or diagrams, use draftsmen capable of preparing drawings clearly in an understandable format.

B. Instructions for the Owner's Personnel: Use experienced instructors thoroughly trained and experienced in operation and maintenance of equipment or system involved to instruct the Owner's operation and maintenance personnel.

1.4 SUBMITTALS

A. Submittal Schedule: Comply with the following schedule for submitting operation and maintenance manuals:

1. Before Substantial Completion, when each installation that requires operation and maintenance manuals is nominally complete, submit 2 draft copies of each manual to the Architect for review. Include a complete index or table of contents of each manual.

   a. The Architect will return 1 copy of the draft with comments within 15 days of receipt.

2. Submit 1 copy of data in final form at least 15 days before final inspection. The Architect will return this copy within 15 days after final inspection, with comments.
3. After final inspection, make corrections or modifications to comply with the Architect's comments. Submit the specified number of copies of each approved manual to the Architect within 15 days of receipt of the Architect's comments.

B. Form of Submittal: Prepare all operation and maintenance manuals in the form of an instructional manual for use by the Owner's operating personnel. Provide the Owner with a “CD” (or more as suitable) of PDF or other approved format files. Organize in a similar manner as a paper manual, with logical folders and sub-folders, and descriptive file names. When the Owner requests paper manuals, organize into suitable sets of manageable size. Where possible, assemble instructions for similar equipment into a single binder for paper submittal.

1. Binders: For each manual, provide heavy-duty, commercial-quality, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to receive 8-1/2-by-11- inch (115-by-280-mm) paper. Provide a clear plastic sleeve on the spine to hold labels describing contents. Provide pockets in the covers to receive folded sheets.

   a. Where 2 or more binders are necessary to accommodate data, correlate data in each binder into related groupings according to the Project Manual table of contents. Cross-reference other binders where necessary to provide essential information for proper operation or maintenance of the piece of equipment or system.

   b. Identify each binder on front and spine, with the printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter covered. Indicate volume number for multiple volume sets of manuals.

2. Dividers: Provide heavy paper dividers with celluloid-covered tabs for each separate Section. Mark each tab to indicate contents. Provide a typed description of the product and major parts of equipment included in the Section on each divider.
3. Protective Plastic Jackets: Provide protective, transparent, plastic jackets designed to enclose diagnostic software for computerized electronic equipment.
4. Text Material: Where maintenance manuals require written material, use the manufacturer's standard printed material. If manufacturer's standard printed material is not available, provide specially prepared data, neatly typewritten, on 8-1/2-by-11-inch (115-by-280-mm), 20-lb/sq. ft. (75-g/sq. m) white bond paper.
5. Drawings: Where maintenance manuals require drawings or diagrams, provide reinforced, punched binder tabs on drawings and bind in with text.

   a. Where oversize drawings are necessary, fold drawings to the same size as text pages and use as a foldout.

   b. If drawings are too large to be used practically as a foldout, place the drawing, neatly folded, in front or rear pocket of binder. Insert a typewritten page indicating drawing title, description of contents, and drawing location at the appropriate location in the manual.

1.5 MANUAL CONTENT

A. In each manual include information specified in the individual Specification Section and the following information for each major component of building equipment and its controls:

1. General system or equipment description.
2. Design factors and assumptions.
3. Copies of applicable Shop Drawings and Product Data.
4. System or equipment identification, including:
   a. Name of manufacturer.
   b. Model number.
   c. Serial number of each component.

5. Operating instructions.
6. Emergency instructions.
7. Wiring diagrams.
8. Inspection and test procedures.
9. Maintenance procedures and schedules.
10. Precautions against improper use and maintenance.
11. Copies of warranties.
12. Repair instructions including spare parts listing.
13. Sources of required maintenance materials and related services.
14. Manual index.

B. Organize each manual into separate Sections for each piece of related equipment. As a minimum, each manual shall contain a title page; a table of contents; copies of Product Data, supplemented by Drawings and written text; and copies of each warranty, bond, and service contract issued.

1. Title Page: Provide a title page in a transparent, plastic envelope as the first sheet of each manual. Provide the following information:

   a. Subject matter covered by the manual.
   b. Name and address of the Project.
   c. Date of submittal.
   d. Name, address, and telephone number of the Prime Contractor.
   e. Name and address of the Architect.
   f. Cross-reference to related systems in other operation and maintenance manuals.

2. Table of Contents: After title page, include a typewritten table of contents for each volume, arranged systematically according to the Project Manual format. Include a list of each product included, identified by product name or other appropriate identifying symbol and indexed to the content of the volume.

   a. Where a system requires more than one volume to accommodate data, provide a comprehensive table of contents for all volumes in each volume of the set.

3. General Information: Provide a general information Section immediately following table of contents, listing each product included in the manual, identified by product name. Under each product, list the name, address, and telephone number of the subcontractor or Installer and the maintenance contractor. Clearly delineate the extent of responsibility of each of these entities. Include a local source for replacement parts and equipment.

4. Product Data: Where the manuals include manufacturer's standard printed data, include only sheets that are pertinent to the part or product installed. Mark each sheet to identify each part or product included in the installation. Where the Project includes more than one item in a tabular format, identify each item, using appropriate references from the Contract Documents. Identify data that is applicable to the installation, and delete references to information that is not applicable.

5. Written Text: Prepare written text to provide necessary information where manufacturer's standard printed data is not available, and the information is necessary for proper operation and maintenance of equipment or systems. Prepare written text where it is necessary to provide additional information or to supplement data included in the manual. Organize text in a consistent

format under separate headings for different procedures. Where necessary, provide a logical sequence of instruction for each operation or maintenance procedure.

6. Drawings: Provide specially prepared drawings where necessary to supplement manufacturer's printed data to illustrate the relationship of component parts of equipment or systems or to provide control or flow diagrams. Coordinate these drawings with information contained in project record drawings to assure correct illustration of the completed installation.

    a. Do not use original project record documents as part of operation and maintenance manuals.

7. Warranties, Bonds, and Service Contracts: Provide a copy of each warranty, bond, or service contract in the appropriate manual for the information of the Owner's operating personnel. Provide written data outlining procedures to follow in the event of product failure. List circumstances and conditions that would affect validity of warranty or bond.

1.6 MATERIAL AND FINISHES MAINTENANCE MANUAL

A. Submit three (3) copies of each paper manual, in final form, on material and finishes to the Architect for distribution. Provide one section for architectural products, including applied materials and finishes. Provide a second section for products designed for moisture protection and products exposed to the weather.

    1. Refer to individual Specification Sections for additional requirements on care and maintenance of materials and finishes.

B. Architectural Products: Provide manufacturer's data and instructions on care and maintenance of architectural products, including applied materials and finishes.

    1. Manufacturer's Data: Provide complete information on architectural products, including the following, as applicable:

        a. Manufacturer's catalog number.
        b. Size.
        c. Material composition.
        d. Color.
        e. Texture.
        f. Reordering information for specially manufactured products.

    2. Care and Maintenance Instructions: Provide information on care and maintenance, including manufacturer's recommendations for types of cleaning agents to be used and methods of cleaning. Provide information on cleaning agents and methods that could prove detrimental to the product. Include manufacturer's recommended schedule for cleaning and maintenance.

C. Moisture Protection and Products Exposed to the Weather: Provide complete manufacturer's data with instructions on inspection, maintenance, and repair of products exposed to the weather or designed for moisture-protection purposes.

    1. Manufacturer's Data: Provide manufacturer's data giving detailed information, including the following, as applicable:

        a. Applicable standards.
        b. Chemical composition.
        c. Installation details.
        d. Inspection procedures.
        e. Maintenance information.
        f. Repair procedures.

D. Schedule: Provide complete information in the materials and finishes manual on products specified in the following Sections:

1. Section 04 2000 – Unit Masonry Assembly
2. Section 05 5200 – Handrails and Railings
3. Section 07 1300 – Self Adhering Sheet Waterproofing
4. Section 07 5323 – EPDM Single Ply Membrane Roofing
5. Section 08 4114 – Aluminum-Framed Entrances and Storefronts
6. Section 08 7100 - Door Hardware
7. Section 08 8000 - Glazing
8. Section 09 6800 - Carpeting

1.7 EQUIPMENT AND SYSTEMS MAINTENANCE MANUAL

A. Submit two (2) copies of each manual, in final form, on equipment and systems to the Architect for distribution. Provide separate manuals for each unit of equipment, each operating system, and each electric and electronic system.

1. Refer to individual Specification Sections for additional requirements on operation and maintenance of the various pieces of equipment and operating systems.

B. Equipment and Systems: Provide the following information for each piece of equipment, each building operating system, and each electric or electronic system.

1. Description: Provide a complete description of each unit and related component parts, including the following:

a. Equipment or system function.
b. Operating characteristics.
c. Limiting conditions.
d. Performance curves.
e. Engineering data and tests.
f. Complete nomenclature and number of replacement parts.

2. Manufacturer's Information: For each manufacturer of a component part or piece of equipment, provide the following:

a. Printed operation and maintenance instructions.
b. Assembly drawings and diagrams required for maintenance.
c. List of items recommended to be stocked as spare parts.

3. Maintenance Procedures: Provide information detailing essential maintenance procedures, including the following:

a. Routine operations.
b. Troubleshooting guide.
c. Disassembly, repair, and reassembly.
d. Alignment, adjusting, and checking.

4. Operating Procedures: Provide information on equipment and system operating procedures, including the following:

a. Startup procedures.
b. Equipment or system break-in.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Instructions on stopping.
f. Shutdown and emergency instructions.
g. Summer and winter operating instructions.
h. Required sequences for electric or electronic systems.
i. Special operating instructions.

5. Servicing Schedule: Provide a schedule of routine servicing and lubrication requirements, including a list of required lubricants for equipment with moving parts.

6. Controls: Provide a description of the sequence of operation and as-installed control diagrams by the control manufacturer for systems requiring controls.

7. Coordination Drawings: Provide each Prime Contractor's Coordination Drawings.

    a. Provide as-installed, color-coded, piping diagrams, where required for identification.

8. Valve Tags: Provide charts of valve-tag numbers, with the location and function of each valve.

9. Circuit Directories: For electric and electronic systems, provide complete circuit directories of panelboards, including the following:

    a. Electric service.
    b. Controls.

C. Schedule: Provide complete information in the equipment and systems manual on all new equipment provided.

3.1 INSTRUCTIONS FOR THE OWNER'S PERSONNEL

A. Prior to final inspection, instruct the Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Provide instruction at mutually agreed upon times.

1. For equipment that requires seasonal operation, provide similar instruction during other seasons.
2. Use operation and maintenance manuals for each piece of equipment or system as the basis of instruction. Review contents in detail to explain all aspects of operation and maintenance.

END OF SECTION 01 78 23

SECTION 01 78 36 - WARRANTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for warranties required by the Contract Documents, including manufacturer’s standard warranties on products and special warranties.

1. Refer to the General Conditions for terms of the Prime Contractor's period for correction of the Work.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 01 Section "Submittal Procedures" specifies procedures for submitting warranties.
2. Division 01 Section "Contract Closeout" specifies contract closeout procedures.
3. Sections for specific requirements for warranties on products and installations specified to be warranted.
4. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

C. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Prime Contractor of the warranty on the Work that incorporates the products. Manufacturer's disclaimers and limitations on product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Prime Contractor.

D. Separate Prime Contracts: Each Prime Contractor is responsible for warranties related to its own contract.

1.3 DEFINITIONS

A. Standard product warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

B. Special warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.4 WARRANTY REQUIREMENTS

A. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.

B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. The Prime Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

D. Owner's Recourse: Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, or remedies.

1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

E. Where the Contract Documents require a special warranty, or similar commitment on the Work or part of the Work, the Owner reserves the right to refuse to accept the Work, until the Prime Contractor presents evidence that entities required to countersign such commitments are willing to do so.

1.5 SUBMITTALS

A. Submit written warranties to the Architect prior to the date certified for Substantial Completion. If the Architect's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Architect.

1. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Prime Contractor during the construction period, submit properly executed warranties to the Architect within 15 days of completion of that designated portion of the Work.

B. When the Contract Documents require the Prime Contractor, or the Prime Contractor and a subcontractor, supplier or manufacturer to execute a special warranty, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner, through the Architect, for approval prior to final execution.

1. Refer to Divisions 02 through 28 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Form of Submittal: At Final Completion compile 2 copies of each required warranty properly executed by the Prime Contractor, or by the Prime Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

D. Bind warranties and bonds in heavy-duty, commercial-quality, durable 3-ring, vinyl-covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (115-by-280-mm) paper.

1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address, and telephone number of the Installer.
2. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project title or name, and name of the Prime Contractor.
3. When warranted construction requires operation and maintenance manuals, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 78 36

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Miscellaneous record submittals.

B. Related Sections include the following:

1. Division 01 Section 011250 "Multiple Contract Summary" for coordinating Project Record Documents covering the Work of multiple contracts.
2. Division 01 Section 017300 “Execution” for property survey requirements.
3. Division 01 Section 017700 "Closeout Procedures" for general closeout procedures.
4. Division 01 Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
5. Division 01 Section 019113 “General Commissioning Requirements” for additional information and procedures.
6. Divisions 02 through 33 Sections for specific requirements for Project Record Documents of products in those Sections.

1.3 SUBMITTALS

A. Record Drawings: Comply with the following:

1. Each Prime Contractor shall scan and submit one marked-up .pdf set of record drawings electronically to the Architect and Construction Manager.
2. Submit each drawing whether or not changes and additional information were recorded.
3. Each Prime Contractor shall submit requirements of the Code Enforcement office and Township, City, and/or Boro officials on annotated PDF electronic files and directories and/or paper copies of each submittal as required.

B. Miscellaneous Record Submittals:

1. See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit required annotated PDF electronic files and directories and/or paper copies of each submittal as required.

1.4 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Accurately record information in an understandable drawing technique.
    c. Record data as soon as possible after obtaining it.
    d. Record and check the markup before enclosing concealed installations.

2. Content: Types of items requiring marking include, but are not limited to, the following:

    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Depths of foundations.
    d. Locations and depths of underground utilities.
    e. Revisions to routing of piping and conduits.
    f. Revisions to electrical circuitry.
    g. Actual equipment locations.
    h. Duct size and routing.
    i. Locations of concealed internal utilities.
    j. Changes made by Change Order or Construction Change Directive.
    k. Changes made following Architect's written orders.
    l. Details not on the original Contract Drawings.
    m. Field records for variable and concealed conditions.
    n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Architect and Construction Manager.
    e. Name of Contractor.

C. Township, City, and Boro requirements for Record Drawings:

1. In addition to requirements specified in this section and other sections of the specifications, Record Drawings shall include the requirements of the Code Enforcement office and Township, City, and/or Boro officials.

1.5 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals in format required by Architect of marked-up miscellaneous record submittals.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.6 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store Record Documents and samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's and Construction Manager’s reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of all systems, subsystems, and equipment.
2. Training in operation and maintenance of all systems, subsystems, and equipment.
3. Demonstration and training video recordings.

B. Related Sections include the following:

1. Division 01 Section "Project Management and Coordination" for requirements for pre-instruction conferences.
2. Division 01 Section “Quality Requirements” for operational and maintenance procedures and training instruction qualifications.

1.3 SUBMITTALS

A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a list of training modules and schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. At completion of training, submit two complete training manuals for Owner's use.

B. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names, and addresses of architects and owners, and other information specified.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

E. Provide approved final Operations and Maintenance Manuals for use during the training sessions.

1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Schedule training only after all systems have been tested and are fully operational.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner’s personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

1.6 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:

1. HVAC systems, air distribution systems and terminal equipment and devices.
2. HVAC instrumentation and controls.
3. Electrical service and distribution system.
4. Packaged engine generators, including transfer switches.
5. Lighting equipment and controls.
6. Communication systems, including equipment. Inter-communication, clocks and programming voice and data and television.
7. Fire suppression system.
8. Plumbing systems.
9. Equipment.
10. Finishes.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

a. System, subsystem, and equipment descriptions.
b. Performance and design criteria if Contractor is delegated design responsibility.
c. Operating standards.
d. Regulatory requirements.
e. Equipment function.
f. Operating characteristics.
g. Limiting conditions.
h. Performance curves.

2. Documentation: Review the following items in detail:

a. Emergency manuals.
b. Operations manuals.
c. Maintenance manuals.
d. Project Record Documents.
e. Identification systems.
f. Warranties and bonds.

g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
   i. Operating procedures for emergencies.
   j. Operating procedures for system, subsystem, or equipment failure.
   k. Seasonal and weekend operating instructions.
   l. Required sequences for electric or electronic systems.
   m. Special operating instructions and procedures.

5. Adjustments: Include the following:

   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

   a. Diagnostic instructions.
   b. Test and inspection procedures.

7. Maintenance: Include the following:

   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning.
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.

8. Repairs: Include the following:

   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module(s). Assemble training modules into a combined training manual.

B. Set up instructional equipment at instruction location.

C. Provide the final training manual, a site-specific agenda, and the resume of the training instructor to the Construction Manager two weeks prior to the scheduled training session.

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Owner will furnish Contractor with names and positions of participants.

C. Scheduling:

1. Schedule training only after system has been tested and is fully operational.
2. Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season. The Contractor shall include one initial training and schedule training with Owner, through CM, with at least fourteen days' advance notice. Start up and commissioning of systems must be completed before scheduling initial instructional session.
3. For major systems equipment, the Contractor shall include one (1) follow-up training to address questions or concerns from the Owner after the equipment has been in service for a period of six (6) to twelve (12) months.

D. Review all valve tags, labeling and access locations and provide summary or plans of all valves, shutoffs, and maintenance access locations.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

F. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately.

B. Documentation: Provide video of training session in digital format requested by Owner and provide access of files to Owner within 10 days of training session. One accessible copy must be provided on thumb drive or CD/DVD format.

END OF SECTION 01 79 00

SECTION 01 81 19 - INDOOR AIR QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. General: This section provides requirements for Baseline Indoor Air Quality (IAQ) Testing for maximum indoor pollutant concentrations for acceptance of the facility.

B. Indoor Air Quality Testing (IAQ Testing): The Owner's Testing Agency shall conduct this testing outside of the Construction Contract and must provide a copy of the report documenting the results of IAQ testing. This IAQ testing shall be conducted with the cooperation of, and in coordination with, the GC, HVAC, EC and PC.

1.3 RELATED SECTIONS

A. Coordinate with Commissioning activities specified in Section 019113 "General Commissioning Requirements".

B. Coordinate with Division 23 Section "Testing, Adjusting and Balancing".

1.4 SUBMITTALS

A. Baseline IAQ Testing: Submit a report for each test site specified for IAQ baseline testing as prescribed herein below and in Division 23 "Testing, Adjusting, and Balancing." Report on air concentrations of targeted pollutants identified in Subsection 3.1 of this section.

1.5 SEQUENCING AND SCHEDULING

A. Identify, program, and schedule all IAQ testing well in advance of completing construction in a manner to prevent delays to the performance of the work of this Contract in order to perform and complete all testing after the completion of construction activities and prior to occupancy.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 BASELINE IAQ TESTING

A. HVAC System Verification: To assure compliance with recognized standards for indoor air quality including ASHRAE Standard 62.1-2010 or a local equivalent (whichever is more stringent), the HVAC Contractor shall verify the performance of each HVAC system prior to IAQ Testing, including space temperature and space humidity uniformity, outside air quantity, filter installation, drain pan operation, and any obvious contamination sources.

1. Factors that contaminate indoor air, such as dust entering HVAC systems and ductwork, improper storage of materials on-site and poor housekeeping, shall be minimized.

B. Indoor Air Quality Testing: Upon verification of HVAC system operation the Owner may, at its discretion, hire an independent contractor to test levels of indoor air contaminants for compliance with specified requirements.

1. A test plan shall be submitted to all Contractors for coordination with their activities. The plan shall specify procedures, times, instrumentation, and sampling methods that will be employed.
2. Conduct baseline IAQ testing using testing protocols consistent with the United States Environmental Protection Agency Compendium of Methods for the Determination of Air Pollutants in Indoor Air.
3. Perform IAQ testing for at least the minimum number of required sampling locations, determined as follows: For each portion of the building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq. ft., or for each contiguous floor area, whichever is larger, and include areas with the least ventilation as calculated by Ventilation Rate Procedure of ASHRAE Standard -2010 or a local equivalent (whichever is more stringent), and greatest presumed source strength as identified by Owner.

   a) Verify areas to be tested with the Owner's Representative. Areas with 100% outside air ventilation rates, such as laboratories, are excluded from these testing requirements. The Owner's Representative is the sole judge of areas exempt from testing.

4. Perform IAQ testing following the completion of all interior construction activities and prior to occupancy. The building shall have all interior finishes installed, including but not limited to millwork, doors, paint, carpet and acoustic tiles. Perform testing prior to installation of furniture, workstation components, and casework.
5. Perform IAQ testing within the breathing zone, between 3’-0” and 6’-0” above the finished floor and over a minimum 4-hour period.
6. Collect air samples during normal occupied hours (prior to occupancy) with the building ventilation system starting at the daily normal start times and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
7. Sample and record outside air levels of formaldehyde and TVOC contaminants at three outside air locations (as determined by Owner) simultaneously with indoor tests to establish basis of comparison for these contaminant levels by averaging the three outdoor readings for each contaminant.
8. Perform airborne mold and mildew sampling to identify species present with simultaneous indoor and outdoor readings.
9. Acceptance of respective portions of the building by the Owner is subject to compliance with specified limits of indoor air quality contaminant levels.

C. Compliance Indoor air quality shall conform to the following standards and limits:

1. Carbon Monoxide: Not to exceed 9 ppm.
2. Carbon Dioxide: Not to exceed 530 ppm higher than outdoor ambient levels.
3. Airborne Mold and Mildew: Indoor species distribution cannot vary by more than 10% from exterior sampling speciation.
4. Maximum Air Concentration Standards: Indoor room air concentration levels, emission rates, and qualities of the listed contaminants shall not exceed the limits specified in Table 3.1 below.

D. Test Reports: Prepare test reports showing the results and location of each test, a summary of the HVAC operating conditions, a listing of any discrepancies and recommendations for corrective actions, if required.

1. Include certification of test equipment calibration with each test report.

E. For each sampling point where the maximum concentration limits listed in Table 3.1 are exceeded, the HVAC Contractor is responsible for conducting additional flush-out with outside air and retesting the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting non-complying building areas, take samples from the same locations as in the first test. Retesting shall be performed at no additional expense to the Owner.

Table 3.1 MAXIMUM INDOOR AIR CONCENTRATION STANDARDS

Maxiumum concentration levels, by contaminant and testing method					
Contaminant			**Maximum concentration**	**ASTM and U.S. EPA methods**	**ISO method**
Particulates	**PM10** (for all buildings)		50 µg/m3 Healthcare only: 20 µg/m3	EPA Compendium Method IP-10	ISO 7708
	PM2.5 (for buildings in EPA nonattainment areas for PM2.5, or local equivalent)		15 µg/m3		
Ozone (for buildings in EPA nonattainment areas for Ozone, or local equivalent)			0.075 ppm	ASTM D5149 - 02	ISO 13964
Carbon monoxide (CO)			9 ppm; no more than 2 ppm above outdoor levels	EPA Compendium Method IP-3	ISO 4224
Total volatile organic compounds (TVOCs)			500 µg/m3 Healthcare only: 200 µg/m3	EPA TO-1, TO-17, or EPA Compendium Method IP-1	ISO 16000-6
Formaldehyde			27 ppb Healthcare only: 16.3 ppb	ASTM D5197, EPA TO-11, or EPA Compendium Method IP-6	ISO 16000-3
Target volatile organic compounds*	1	Acetaldehyde	140 µg/m3		
	2	Benzene	3 µg/m3	ASTM D5197, EPA TO-1, TO-17, or EPA Compendium Method IP-1	ISO 16000-3, ISO16000-6
	3	Carbon disulfide	800 µg/m3		
	4	Carbon tetrachloride	40 µg/m3		
	5	Chlorobenzene	1000 µg/m3		
	6	Chloroform	300 µg/m3		
	7	Dichlorobenzene (1,4-)	800 µg/m3		
	8	Dichloroethylene (1,1)	70 µg/m3		
	9	Dimethylformamide (N,N-)	80 µg/m3		
	10	Dioxane (1,4-)	3000 µg/m3		
	11	Epichlorohydrin	3 µg/m3		
	12	Ethylbenzene	2000 µg/m3		
	13	Ethylene glycol	400 µg/m3		
	14	Ethylene glycol monoethyl ether	70 µg/m3		
	15	Ethylene glycol monoethyl ether acetate	300 µg/m3		
	16	Ethylene glycol monomethyl ether	60 µg/m3		
	17	Ethylene glycol monomethyl ether acetate	90 µg/m3		
	18	Hexane (n-)	7000 µg/m3		
	19	Isophorone	2000 µg/m3		
	20	Isopropanol	7000 µg/m3		
	21	Methyl chloroform	1000 µg/m3		
	22	Methylene chloride	400 µg/m3		
	23	Methyl *t*-butyl ether	8000 µg/m3		
	24	Naphthalene	9 µg/m3		
	25	Phenol	200 µg/m3		
	26	Propylene glycol monomethyl ether	7000 µg/m3		
	27	Styrene	900 µg/m3		
	28	Tetrachloroethylene (Perchloroethylene)	35 µg/m3		
	29	Toluene	300 µg/m3		
	30	Trichloroethylene	600 µg/m3		
	31	Vinyl acetate	200 µg/m3		
	32-34	Xylenes, technical mixture (m-, o-, pxylene combined)	700 µg/m3		

SECTION 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:

1. Commissioning: Commissioning is a systematic process involving the Contractors, the Architect, Construction Manager, Manufacturer, and other entities to ensure that selective building systems perform interactively according to the design intent and the Owner's operational needs. This is achieved by beginning in the design phase and documenting design intent and continuing through construction, acceptance, and the warranty period with actual verification of performance. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training.

2. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:

   a. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
   b. Verify and document proper performance of equipment and systems.
   c. Verify that O&M documentation left on site is complete.
   d. Verify that the Owner's operating personnel are adequately trained.
   e. The commissioning process does not take away from or reduce the responsibility of the Contractor to meet the Contract Documents.

3. Related Sections include the following:

   a. General Conditions, Article 9.8, for definition of Substantial Completion.
   b. Sections 01 97 00 (Closeout procedures), 01 78 00 (Closeout Submittals), and 01 98 00 (Demonstration and Training) for additional mechanical, plumbing and electrical closeout Commissioning requirements.
   c. Division 07: Building insulation sections
   d. Division 07: Roofing sections
   e. Division 08: Door and window sections
   f. Division 21: Fire suppression
   g. Division 22: Plumbing
   h. Division 23: HVAC
   i. Division 26: Electrical
   j. Division 27: Communication
   k. Division 28: Electrical safety & security
   l. Sections 21 08 00, 22 08 00, 23 08 00 and 26 08 00 for additional mechanical, fire protection, plumbing and electrical Commissioning requirements.

4. **For this project, the Commissioning Authority (CA) for each system shall be the contractor responsible for furnishing and installing the systems, equipment, and controls under the Contract. The CM, with the independent Testing Adjusting, and Balancing/Commissioning Verification Agency (TAB/CVA), shall verify that all CA responsibilities and commissioning**

are being implemented. The CA shall have a minimum of three years of documented experience in commissioning similar systems. The CA can be a member of the contractor's workforce and the responsibilities can be assigned to the Superintendent or other senior level staff who has experience in startup and operation of the specified systems.

1.3 ABBREVIATIONS

A. Abbreviations: The following are common abbreviations used in the *Specifications* and in the *Commissioning Plan.* Definitions are found in Article 1.7.

A/E Architect and Design Engineers
BMS Building Management System
CA Commissioning authority
CC Construction checklist
Cx Commissioning
Cx Plan Commissioning Plan document
EC Electrical Contractor
ATCC Automatic Temperature Control Contractor
GC General Contractor
HC HVAC Contractor
IC Installing Contractor
PC Plumbing Contractor
CM Construction Manager
Subs Subcontractors or Sub-subcontractors
TAB/CVA Testing, Adjusting & Balancing AND Commissioning Verification Agency

1.4 DEFINITIONS

A. Use of terms and abbreviations referring to the Building Automation and Automatic Temperature Controls (ATC) Contractor and the Testing and Balancing (TAB) Contractor shall be understood to mean the Subcontractors to the HVAC Contractor for these specific portions of the Work.

B. Acceptance Phase - phase of construction after startup and initial checkout when functional performance tests, O&M documentation review and training occur.

C. Approval - acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes according to the Contract Documents.

D. Architect / Engineer (A/E) - the Owner's design consultants who comprise the design team, including the HVAC mechanical designer/engineer and the electrical designer/engineer.

E. Owner's Project Requirements - The Owner's Project Requirements is the documentation of the primary thought processes and assumptions behind design decisions that were made to meet the design intent. The Owner's Project Requirements describes the systems, components, conditions, and methods chosen to meet the intent. Some reiterating of the design intent may be included.

F. Commissioning Authority (CA) - The CA directs and coordinates the day-to-day commissioning activities. CA assigned by the Contractor does not take an oversight role. **For this project, the CA's responsibilities shall be assigned to the contractor responsible for installation of the building system under the contract.**

G. Testing, Adjusting, and Balancing/Commissioning Verification Agency (TAB/CVA) - reviews commissioning procedures and protocols developed by CA and also verifies and approves commissioning.

H. Commissioning Plan - an overall plan, developed after bidding that provides the structure, schedule and coordination planning for the commissioning process.

I. Construction Checklist (CC) - a list of items to inspect and elementary component tests to conduct to verify proper installation of equipment/work; provided by the CA for each Contractor. Construction checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some construction checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three-phase pump motor of a chiller system). Construction Checklists are used prior to functional testing. Construction checklists augment and are combined with the manufacturer's start-up checklist and the specified equipment checkout sheet(s). Even without a

commissioning process, contractors typically perform some, if not many, of the construction checklist items a commissioning authority will recommend. However, few contractors document in writing the execution of these checklist items. Therefore, for most equipment, the contractors execute the checklists on their own. The commissioning authority only requires that the procedures be documented in writing and does not witness much of the completion of construction checklists, except for larger or more critical pieces of equipment.

J. Contract Documents - the documents binding on parties involved in the construction of this project (drawings, specifications, change orders, amendments, contracts, etc.).

K. Control system - the central building energy management control system.

L. Data logging - monitoring flows, currents, status, pressures, etc. of equipment using stand-alone data loggers separate from the control system.

M. Deferred Functional Tests – FTs that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design, or other site conditions that prevent the test from being performed.

N. Deficiency - a condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents.

O. Design Intent - a dynamic document that provides the explanation of the ideas, concepts and criteria that are considered to be very important to the owner. It is initially the outcome of the programming and conceptual design phases.

P. Factory Testing - testing of equipment on-site or at the factory by factory personnel with a Project Manager present.

Q. Functional Performance Test (FT) - test of the dynamic function and operation of equipment and systems using manual (direct observation), trending or remote monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water testing, adjusting, and balancing (TAB) is not functional testing, in the commissioning sense of the word. The TAB/CVA Agency's primary work is setting up the system flows, and pressures as specified, while functional testing is verifying that which has already been set up. The Commissioning Authority develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor. FTs are performed after construction checklists and start-up activities are complete.

R. Indirect Indicators - indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed.

S. Installing Contractor – contractor who installs specific equipment and/or systems.

T. Manual Test - using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").

U. Monitoring - the recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.

V. Non-Compliance - see Deficiency.

W. Non-Conformance - see Deficiency.

X. Over-written Value - writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50F to 75F to verify economizer operation). See also "Simulated Signal."

Y. Owner-Contracted Tests - tests paid for by the Owner outside the contract and for which the CA does not oversee. These tests will not be repeated during functional tests if properly documented.

Z. Phased Commissioning - commissioning that is completed in phases (by floors, for example) due to the size of the structure or other scheduling issues, in order minimize the total construction time.

AA. Construction Manager (CM) – Owner's representative who will oversee all activities required for commissioning.

BB. Sampling. - Functionally testing only, a fraction of the total number of identical or near identical pieces of equipment. Refer to Subparagraph 3.4-F.8 for details.

CC. Seasonal Performance Tests – Functional tests that are deferred until the system(s) will experience conditions closer to their design conditions.

DD. Simulated Condition - condition that is created for the purpose of testing the response of a system (e.g., applying a hair blower to a space sensor to see the response in a VAV box).

EE. Simulated Signal - disconnecting a sensor and using a signal generator to send an amperage, resistance, or pressure to the transducer and DDC system to simulate a sensor value.

FF. Specifications - the construction specifications of the Contract Documents.

GG. Startup - the initial starting or activating of dynamic equipment, including executing construction checklists.

HH. Subs - Subcontractors or Sub-subcontractors who furnish and install building components and systems.

II. Test Procedures - the step-by-step process, which must be executed to fulfill the test requirements. The CA develops the test procedures.

JJ. Test Requirements - requirements specifying what modes and functions, etc. shall be tested. The test requirements are not the detailed test procedures.

KK. Trending - monitoring using the building management system.

LL. Vendor - supplier of equipment.

MM. Warranty Period - warranty period for entire project, including equipment components. Warranty begins at Substantial Completion and extends for at least the duration specified.

1.5 COORDINATION

A. Commissioning Team. The members of the commissioning team consist of the CA, the Contractors, the TAB/CVA, the CM, the Architect and Design Engineers (particularly the Mechanical Engineer), and the ATCC and other installing Subs or suppliers of equipment or work that is part of systems to be commissioned. If known, the Owner's building or plant operator/engineer is also a member of the commissioning team.

B. Management. The CA directs and coordinates the commissioning activities and reports to the owner. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents. The CA's responsibilities are the same regardless of who hired the CA. The TAB/CVA will verify all of the CA's activities and provide a report.

C. Scheduling. The CA will work with the TAB/CVA and the Contractors according to established protocols to schedule the commissioning activities. The CA will provide sufficient notice to the Contractors for scheduling commissioning activities. Each Contractor shall provide scheduling information for his commissioning activities to the GC. The GC, with assistance from the CA, shall coordinate and integrate all commissioning activities into the master Project Construction Schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

1. The CA, in coordination with the TAB/CVA, will provide the initial schedule of primary commissioning events at the initial commissioning meeting. The Commissioning Plan will provide a format for this schedule. As construction progresses and more detailed schedules are available from the Contractors, the CA will adjust the commissioning schedule accordingly.

1.6 COMMISSIONING PROCESS

A. Commissioning Plan. The Commissioning Plan will be developed and provided by the CA after certain information is received from and coordinated between the Contractors. The TAB/CVA shall review and approve the plan and protocols. The Cx Plan shall be binding on the Contractors. The Cx Plan provides guidance in the execution of the commissioning process. The Specifications will take precedence over the Commissioning Plan.

B. Commissioning Process. The following narrative provides a brief overview of the minimum and typical commissioning tasks during construction and the general order in which they occur.

1. Commissioning during construction begins with an initial Commissioning meeting conducted by the CA and the TAB/CVA where the commissioning process is reviewed with the commissioning team members.
2. Additional meetings will be required throughout construction, scheduled by the CA and TAB/CVA with necessary parties attending, to plan, coordinate, schedule future activities and resolve problems.
3. Equipment documentation is distributed by the CM to the CA and TAB/CVA during the normal submittal process, including manufacturers' detailed start-up procedures.
4. The CA works with each Contractor in developing startup plans and documentation formats, including providing each Contractor with construction checklists to be completed during the startup process. The lists will be reviewed and approved by the TAB/CVA.
5. In general, the checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels with construction checklists being completed before functional testing.
6. The Contractors, under their own direction, execute and document the construction checklists and perform startup and initial checkout. The CA, with the oversight of the TAB/CVA documents that the checklists and startup were completed according to the approved plans. This may include the CA and the TAB/CVA witnessing startup of selected equipment. Refer to Article 3.2.
7. The CA, with the oversight and review of the TAB/CVA, develops specific equipment and system functional performance test procedures. The Contractors review the procedures. Refer to Article 3.4.
8. The functional testing and procedures are executed and documented by the Contractors and their CA, under the oversight of the TAB/CVA. Refer to Article 3.4.
9. Items of non-compliance are resolved at the commissioning meetings.
10. Items of non-compliance in material, installation or setup are corrected by the Contractors at the Contractors' expense and the system retested. Refer to Articles 3.2, 3.4 & 3.5.
11. The CA and TAB/CVA review the O&M documentation for completeness.
12. Except for deferred/ seasonal testing, the project will not be considered substantially complete until the conclusion of Commissioning functional testing procedures as defined in the Cx Plan and Contract Documents.
13. The CA and TAB/CVA review, pre-approve and coordinate the training provided by the Contractors and verifies that it was completed. Refer to Article 3.7.
14. Deferred testing is conducted, as specified, or required. Refer to Article 3.8.

1.7 RESPONSIBILITIES

A. The responsibilities of various parties in the commissioning process are provided in this Section 019113 and in Divisions 21, 22, 23, and 26. Responsibilities will be similarly listed in the Commissioning Plan prepared by the CA. The TAB/CVA and CM shall review and approve the services and responsibilities and the plan.

1. Where field commissioning activities require the participation of multiple Contractors and other entities, the CA who furnishes the equipment will assign the appropriate Prime Contractor to be responsible for coordinating the completion of the checklists with the oversight and verification of the TAB/CVA. As with other aspects of construction, the Contractors shall cooperate and coordinate accordingly with all entities involved.

B. All Parties:

1. Follow the Commissioning Plan.
2. Attend an initial commissioning meeting and additional meetings, as necessary.

C. Commissioning Authority (CA)

1. The CA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CA may assist with problem-solving, non-conformance or deficiencies, but ultimately that responsibility resides with the general contractor and the A/E. The primary role of the CA is to ensure that the Owner's project requirements are achieved through the construction and operation of the facility.

D. Owner's Representative (CM)

1. Construction and Acceptance Phase

a. The Owner manages the CxA contract.
b. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training sessions.
c. Provide final approval for the completion of the commissioning work.

2. Warranty Period

a. Ensure that any seasonal or deferred testing and any deficiency issues are addressed.

E. All Contractors:

1. Construction and Acceptance Period:

a. Facilitate coordination of the commissioning work by the CA, and with the GC and TAB/CVA, ensure that commissioning activities are being scheduled into the master Project Construction Schedule.
b. Include the cost of commissioning activities pertinent to the Contract in the bid.
c. In each purchase order or subcontract written, include requirements for submittal data, O&M data, commissioning tasks and training.
d. Ensure that all sub-contractors execute their commissioning responsibilities according to the Contract Documents and schedule.
e. Contractor's representative shall attend the initial commissioning meeting and other commissioning meetings scheduled by the CM and CA to facilitate the Cx process unless such presence is not necessary (as determined by the CA).
f. Coordinate and schedule the training of owner personnel through CM.

1) Prepare O&M manuals, according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

g. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
h. Assist in equipment testing per agreements with sub-contractors.
i. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to the Contract Documents.
j. Provide DVD recordings with audio of the training sessions for Owner's personnel, cataloged in an approved format, and submitted with the O&M manuals.

k. Provide information requested by the CA and CM regarding equipment sequence of operation and testing procedures.

2) Review test procedures for equipment installed by factory representatives.

2. Warranty Period:

a. Ensure that Subcontractors execute seasonal or deferred functional performance testing, witnessed by the CA, according to the specifications.

F. Ensure that Subcontractors correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

1.8 SYSTEMS TO BE COMMISSIONED

A. The commissioning program shall include but is not limited to the following systems, equipment, components for complete system verification including the following:

GENERAL SYSTEMS / ARCHITECTURAL SYSTEMS	**PLUMBING /FIRE PROTECTION SYSTEMS**
1. Motorized Operable Partition	1. Domestic Hot Water Heaters
2. External Building Envelope	2. Domestic Water System Pumps
	3. Fire Suppression System
HVAC / MECHANICAL SYSTEMS	4. Plumbing Hot Water Generation System
1. All mechanical equipment listed in the plans and specifications	5. Natural Gas System
2. Building Automation System / ATC	6. Domestic Water Distribution Systems
3. Split Air-Cooled Chiller and remote condensing units	7. System flows
4. Chilled water pumps	
5. Water to Water Heat Pump	**ELECTRICAL SYSTEMS**
6. Water to water Heat Pump circulating Pumps	1. Fire Detection & Alarm System
7. Boiler & Boiler pump	2. Media Distribution Network System
8. Heating water pumps	3. Intercom System
9. 4-Pipe AHUs	4. Lighting & Lighting Control System
10. 4-Pipe DOAS	5. Emergency Generator System and controls
11. ERVs	6. Emergency Power System
12. HW Cabinet Unit Heaters, HW Fan Forced Unit Heaters	7. Fire Protection system, including Fire Pump and controls
13. Fans	8. Fire Alarm System
14. Ductless Split Systems	9. Structured Voice & Data Cabling System
15. Dehumidification Units	10. Sound Reinforcement Systems
16. MODs and associated components (boiler combustion air, generator combustion air, etc.)	11. Panels and Switchgear
17. Temperature/Humidity Sensors	
18. Pressure Sensors	
19. Sequence of Operations	
20. Damper/Valve Actuators	

1.9 REFERENCE STANDARDS

A. AABC – Associated Air Balancing Council (AABC) Commissioning Guideline.

B. AABC Commissioning Group.

C. Building Commissioning Association.

D. ASHRAE – Guideline 1-1996 The HVAC Commissioning Process.

E. ASHRAE Guideline 0-2005: The Commissioning Process.

F. ASHRAE Standard 202-2013: Commissioning Process for Buildings and Systems.

G. ASHRAE – Guideline 1.1: HVAC&R Technical Requirements for the Commissioning Process.

H. SMACNA – HVAC Systems Commissioning Manual

1.10 COORDINATION AND COOPERATION

A. Installing Contractor responsible for Work under Divisions 22, 23 and 26 shall provide commissioning support as described in this document and as included in the design documents.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. All testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Installing Contractor for the equipment being tested, unless indicated otherwise. For example, the HC shall be responsible for all testing equipment for the HVAC system and controls except for equipment specific to and used by the TAB/CVA Agency for its responsibilities. The Installing Contractor shall provide two-way radios for use during testing by its personnel and the CA.

B. Special equipment, tools and instruments (only available from vendor; specific to a piece of equipment) required for testing equipment according to the Contract Documents shall be included in the base bid price and shall be turned over to and become the property of the Owner.

C. Temporary data logging equipment and software required to test equipment will be provided by the CA but shall not become the property of the Owner.

D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

E. Refer to Section 019113, Part 3 for details regarding equipment that may be required to simulate required test conditions.

F. The installing contractor shall coordinate and provide any equipment necessary for access to all systems to accomplish commissioning tasks.

PART 3 - EXECUTION

3.1 MEETINGS

A. Initial Commissioning Meeting: Within 60 days of commencement of construction, the CA, with oversight by the TAB/CVA, will schedule, plan, and conduct a commissioning meeting with the entire commissioning team in attendance. Meeting minutes will be distributed to all parties by the TAB/CVA. Information gathered

from this meeting will allow the CA and TAB/CVA to further develop, maintain and revise the Commissioning Plan, which will be distributed to all parties.

B. Progress Commissioning Meetings: Other meetings will be planned and conducted by the CA, with oversight by the TAB/CVA, as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with particular Contractors. The CA, with oversight by the TAB/CVA, will plan these meetings and will minimize unnecessary time being spent by Contractors.

3.2 REPORTING

A. The Installing Contractor shall provide one copy of approved shop drawings, sequence of operations and startup reports for all commissioned equipment to the CxA. Supplement the shop drawing data with the manufacturer's installation and start-up procedures. This material shall be identical to the literature which will be included in the Operation and Maintenance Manuals.

B. The CA may request additional design narrative from the A/E and Controls (ATC) Contractor, depending on the completeness of the basis of design documentation and sequences provided with the Specifications.

C. These submittals to the CA do not constitute compliance for O&M manual documentation in Division 1. The O&M manuals are the responsibility of the Contractor.

3.3 START-UP, CONSTRUCTION CHECKLISTS AND INITIAL CHECKOUT

A. The following procedures apply to all equipment to be commissioned. Some systems that are not comprised so much of actual dynamic machinery may have very simplified CCs and startup.

B. General: Construction checklists are important to ensure that equipment and systems are hooked up correctly and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full construction checkout. No sampling strategies are used. The start-up and initial checkout testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.

C. Start-up and Initial Checkout Plan: The CA will assist the commissioning team members responsible for startup of equipment in developing detailed start-up plans for all equipment with oversight by the TAB/CVA. The primary role of the CA in this process is to ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed. The TAB/CVA will verify all of the CA's activities and provide a report. Parties responsible for construction checklists and startup are identified in the initial commissioning meeting and in the checklist forms.

1. The CA provides construction checklists and procedures from Section 019113. These checklists indicate required procedures to be executed as part of startup and initial checkout of the systems and the party responsible for their execution.
2. The CA provides these checklists and tests for the appropriate Prime Contractor. Each form will usually have more than one trade responsible for its execution.
3. The Contractor responsible for the purchase of the equipment develops the full start-up plan by combining (or adding to) the CA's checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.

   a. The full start-up plan could consist of something as simple as:

      1) The CA's construction checklists.
      2) The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
      3) The manufacturer's normally used field checkout sheets.

4) For systems that may not have adequate manufacturer startup and checkout procedures, particularly for components being integrated with other equipment, the contractor shall provide the added necessary detail and documenting format to the CA for approval, prior to execution.

4. The Contractor submits the full startup plan to the CA for review and approval.
5. The CA reviews and approves the procedures and the format for documenting them, noting any procedures that need to be added.
6. The CA reviews and submits the above items to the TAB/CVA for review and approval. The TAB/CVA provides a report to the CM and Owner documenting the procedures and recommends any procedures that should be revised or added.

D. Sensor and Actuator Calibration:

1. All field-installed temperature, relative humidity, CO, CO2 and pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated using the methods described below. Alternate methods may be used, if approved by the CA beforehand. All test instruments shall have had a certified calibration within the last 12 months. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.
2. All procedures used shall be fully documented on the construction checklists or other approved forms, clearly referencing the procedures followed and written documentation of initial, intermediate, and final results.
3. Sensor Calibration Methods:

   a. All Sensors: Verify that all sensor locations are appropriate and away from causes of erratic operation. Verify that sensors with shielded cable are grounded only at one end. For sensor pairs that are used to determine a temperature or pressure difference, make sure they are reading within 0.2°F of each other for temperature and within a tolerance equal to 2% of the reading, of each other, for pressure. Tolerances for critical applications may be tighter.
   b. Sensors Without Transmitters - Standard Application: Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or building management system (BMS)) is within the tolerances in the table below of the instrument-measured value. If not, install offset in BMS, calibrate or replace sensor.
   c. Sensors With Transmitters - Standard Application: Disconnect sensor. Connect a signal generator in place of sensor. Connect ammeter in series between transmitter and BMS control panel. Using manufacturer's resistance-temperature data simulate minimum desired temperature. Adjust transmitter potentiometer zero until the ammeter reads 4 mA. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the BMS. Record all values and recalibrate controller as necessary to conform to specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction. Reconnect sensor. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or building management system (BMS)) is within the tolerances in the table below of the instrument-measured value. If not, replace sensor and repeat. For pressure sensors, perform a similar process with a suitable signal generator.
   d. Critical Applications. For critical applications, more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.

4. Tolerances, Standard Applications:

Sensor	Required Tolerance (+/-)	Sensor	Required Tolerance (+/-)
Cooling coil, chilled and condenser water temps	0.4F	Flow rates, water Relative humidity	4% of design 4% of design
AHU wet bulb or dew point	2.0F	Combustion flue temps	5.0F
Hot water coil and boiler water temp	1.5F	Oxygen or CO2 monitor	0.1 % pts
Outside air, space air, duct air temps	0.4F	CO monitor	0.01 % pts
Watthour, voltage & amperage	1% of design	Natural gas and oil flow rate	1% of design
Pressures, air, water and gas	3% of design	Steam flow rate	3% of design
Flow rates, air	10% of design	Barometric pressure	0.1 in. of Hg

5. Valve and Damper Stroke Setup and Check:

   a. MS Readout. For all valve and damper actuator positions checked, verify the actual position against the BMS readout.
   b. Set pumps or fans to normal operating mode. Command valve or damper closed, visually verify that valve or damper is closed and adjust output zero signal as required. Command valve or damper open, verify position is full open and adjust output signal as required. Command valve or damper to a few intermediate positions. If actual valve or damper position doesn't reasonably correspond, replace actuator or add pilot position indicator (for pneumatics).
   c. Closure for heating coil valves (NO): Set heating setpoint 20°F above room temperature. Observe valve open. Remove control air or power from the valve and verify that the valve stem and actuator position do not change. Restore to normal. Set heating setpoint to 20°F below room temperature. Observe the valve close. For pneumatics, by override in the BMS, increase pressure to valve by 3 psi (do not exceed actuator pressure rating) and verify valve stem and actuator position does not change. Restore to normal.
   d. Closure for cooling coil valves (NC): Set cooling setpoint 20°F above room temperature. Observe the valve close. Remove control air or power from the valve and verify that the valve stem and actuator position do not change. Restore to normal. Set cooling setpoint to 20°F below room temperature. Observe valve open. For pneumatics, by override in the BMS, increase pressure to valve by 3 psi (do not exceed actuator pressure rating) and verify valve stem and actuator position does not change. Restore to normal.

E. Execution of Construction Checklists and Startup:

1. Four weeks prior to startup, the Contractor shall schedule startup and checkout with the CA and TAB/CVA and other pertinent entities. Performance of construction checklists, startup and checkout are directed and executed by the Contractor or vendor. When checking off construction checklists, signatures may be required of other Contractors for verification of completion of their work.
2. The CA and TAB/CVA will, at its discretion, observe, at minimum, the procedures for each piece of primary equipment, unless there are multiple units. In no case will the number of units witnessed be less than four on any one building, nor less than 20% of the total number of identical or very similar units.
3. For lower-level components of equipment (e.g.: sensors, controllers), the CA and TAB/CVA will observe a sampling of the construction and start-up procedures. The sampling procedures will be identified in the Commissioning Plan.
4. The Contractors shall execute startup and provide the CA and TAB/CVA with a signed and dated copy of the completed start-up and construction tests and checklists.
5. Only installing individuals that have direct knowledge that a line item task on the construction checklist was actually performed shall initial or check that item off.

F. Deficiencies, Non-Conformance and Approval in Checklists and Startup:

1. The Contractor shall clearly list any outstanding items of the initial start-up and construction procedures that were not completed successfully, at the bottom of each procedures form or on an attached sheet. Each procedures form and any outstanding deficiencies shall be submitted to the CA and TAB/CVA within two days of test completion.
2. The CA and TAB/CVA review each report and submits either a non-compliance report or an approval form to the Contractor. The CA and TAB/CVA shall work with the Contractor to correct and retest deficiencies or uncompleted items. The CA and TAB/CVA will involve the Contractor and others, as necessary. The installing Contractors shall correct all items that are deficient or incomplete in the checklists and tests in a timely manner, notify the CA and TAB/CVA as soon as outstanding items have been corrected, and resubmit an updated start-up report and Statement of Correction on each original noncompliance report.
3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in back charges to the responsible party.

3.3 PHASED COMMISSIONING

A. If the project is a phased project, it requires startup and initial checkout to be executed in phases, phasing will be planned and scheduled in a coordination meeting of the CA and TAB/CVA, Contractors, and ATCC. Results shall be added to the master Project Construction Schedule and the CA's commissioning schedule.

3.4 FUNCTIONAL PERFORMANCE TESTING

A. This article applies to all commissioning functional testing.

B. The general list of equipment and systems to be commissioned is found in this Section.

C. The parties responsible to execute each test shall be the Contractor responsible for furnishing and installing systems.

D. Objectives and Scope: The objective of functional performance testing is to demonstrate that each system is operating according to the Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation, and functioning of the systems.

1. In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested.

E. Development of Test Procedures: Before test procedures are written, the CA and TAB/CVA shall obtain all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. Using the testing parameters and requirements in technical and other sections, the CA shall develop specific test procedures, with oversight by the TAB/CVA, and forms to verify and document proper operation of each piece of equipment and system. Each Contractor or vendor responsible to execute a test shall provide limited assistance to the CA and TAB/CVA in developing the procedures review (answering questions about equipment, operation, sequences, etc.). Prior to execution, the CA shall provide a copy of the test procedures to the Contractors and TAB/CVA who shall review the tests for feasibility, safety, equipment, and warranty protection.

1. The CA and TAB/CVA shall review selective Owner-contracted factory testing or required Owner acceptance tests which the CA and TAB/CVA are not responsible to oversee, including documentation format, and shall determine what further testing or format changes may be required to comply with the Specifications. Redundancy of testing shall be minimized.
2. The purpose of any given specific test is to verify and document compliance with the stated criteria of acceptance given on the test form.
3. The test procedure forms developed by the CA, with oversight by the TAB/CVA, shall include (but not be limited to) the following information:

a. System and equipment or component name(s)
b. Equipment location and ID number
c. Unique test ID number, and reference to unique construction checklist and start-up documentation ID numbers for the piece of equipment
d. Date
e. Project name
f. Participating parties
g. A copy of the specific sequence of operations or other specified parameters being verified
h. Formulas used in any calculations
i. Required pre-test field measurements
j. Instructions for setting up the test.
k. Special cautions, alarm limits, etc.
l. Specific step-by-step procedures to execute the test, in a clear, sequential, and repeatable format
m. Acceptance criteria of proper performance with a Yes / No check box to allow for clearly marking whether or not proper performance of each part of the test was achieved.
n. A section for comments
o. Signatures and date block for the CA

F. Test Methods:

1. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone data loggers. Division 23, 26, 27 and 28 Sections and other sections specify which methods shall be used for each test. The CA may substitute specified methods or require an additional method to be executed, other than what was specified. The TAB/CVA will determine which method is most appropriate for tests that do not have a method specified.
2. Simulated Conditions: Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
3. Overwritten Values: Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, shall be allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate set point to see the desired response. Before simulating conditions or overwriting values, sensors, transducers, and devices shall have been calibrated.
4. Simulated Signals: Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended overusing the sensor to act as the signal generator via simulated conditions or overwritten values.
5. Altering Setpoints: Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the AC compressor lockout work at an outside air temperature below 55F, when the outside air temperature is above 55F, temporarily change the lockout setpoint to be 2F above the current outside air temperature.
6. Indirect Indicators: Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification is completed during startup and initial checkout testing.
7. Setup: Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Contractor executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Contractor shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.
8. Sampling: Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference. No sampling by Contractors is allowed in executing Construction Checklists for startup and initial checkout.

a. A common sampling strategy referenced in the Specifications as the “xx% Sampling—yy% Failure Rule” is defined by the following example.

1) xx = the percent of the group of identical equipment to be included in each sample.
2) yy = the percent of the sample that if failing, will require another sample to be tested.

b. The example below describes a 20% Sampling—10% Failure Rule.

1) Randomly test at least 20% (xx) of each group of identical equipment. In no case test less than three units in each group. This 20%, or three, constitute the “first sample.”
2) If 10% (yy) of the units in the first sample fail the functional performance tests, test another 20% of the group (the second sample).
3) If 10% of the units in the second sample fail, test all remaining units in the whole group.
4) If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CA may stop the testing and require the Contractor to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.

G. Coordination and Scheduling: The Contractors shall provide sufficient notice to the CA and TAB/CVA regarding their completion schedule for the Construction Checklists and startup of all equipment and systems. The CA will schedule functional tests with the Contractors and inform the A/E and TAB/CVA when they will occur. The CA shall direct, witness and document all functional testing of equipment and systems. The TAB/CVA will verify all of the CA’s activities and provide a report. The Contractors shall execute the tests.

1. In general, functional testing shall be conducted after construction and startup has been satisfactorily completed. The control system shall be sufficiently tested and approved by the CA, with oversight by the TAB/CVA, before it is used for TAB or to verify performance of other components or systems. The air balancing and water balancing shall be completed and debugged before functional testing of air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.

H. Test Equipment: Refer to Section 019113, Part 2 for test equipment requirements.

I. Problem Solving: The CA and TAB/CVA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the Contractors and A/E.

3.5 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

A. Documentation. The CA shall witness and document the results of all functional performance tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the Contractors for review. The CA shall provide written report of all issues and action plan for resolving any items. The TAB/CVA will review the CA’s activity and documentation and provide a report noting any issues and a recommended course of action to the CM and Owner.

B. Non-Conformance:

1. The CA, with oversight by the TAB/CVA, will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported to the A/E on a standard non-compliance form.
2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CA, with oversight by the TAB/CVA. In such cases the deficiency and resolution will be documented on the procedure form and reviewed and approved by the TAB/CVA with a written report to the CM.
3. Every effort shall be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CA and TAB/CVA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the Owner and CM.

4. As tests progress and a deficiency is identified, the CA discusses the issue with the executing Contractor and TAB/CVA.

    a. When there is no dispute on the deficiency and the Contractor accepts responsibility to correct it:

        1) The CA documents the deficiency and the Contractor's response and intentions, and they go on to another test or sequence. After the day's work, the CA submits the non-compliance reports to the TAB/CVA for signature, if required. A copy is provided to the Contractor and CA. The Contractor corrects the deficiency, signs the statement of correction at the bottom of the non-compliance form certifying that the equipment is ready to be retested and sends it back to the CA. The TAB/CVA will review the CA's activity and documentation and provide a report noting any issues and a recommended course of action to the CM and Owner.
        2) The Contractor reschedules the test and coordinates with CA and TAB/CVA to establish a time and date that the test is to be repeated.

    b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:

        1) The TAB/CVA will review the CA's activity and documentation and provide a report noting any issues and a recommended course of action to the CM and Owner.
        2) The deficiency shall be documented on the non-compliance form by the CA with oversight by the TAB/CVA with the Contractor's response and a copy given to the A/E and CM to the Contractor representative assumed to be responsible.
        3) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the A/E.
        4) The CA documents the resolution process with oversight by the TAB/CVA.
        5) Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CA. The TAB/CVA will review the CA's activity and documentation and provide a report noting any issues and a recommended course of action to the CM and Owner. The Contractor reschedules the test and notifies the CA and TAB/CVA of the date and time the test is to be repeated. This will occur until satisfactory performance is achieved.

5. Cost of Retesting:

    a. The cost for the Contractor to retest a startup/checkout or functional test, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the responsible parties.
    b. For a deficiency identified, not related to any construction checklist or start-up fault, the following shall apply: The CA and TAB/CVA will direct the retesting of the equipment once at no "charge" to the Contractor for the TAB/CVA's time. However, the TAB/CVA's time for a second retest will be charged to the Contractor, who may choose to recover costs from the responsible Sub.
    c. The time for the TAB/CVA to direct any retesting required because a specific construction checklist or start-up test item, reported to have been successfully completed, but determined during functional testing to be faulty, will be back charged to the Contractor, who may choose to recover costs from the party responsible for executing the faulty construction test.
    d. Refer to "sampling" subparagraph 3.4-F.8 of this Section for requirements for testing and retesting identical equipment.

6. The Contractor shall respond in writing to the CA and TAB/CVA at least as often as commissioning meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.
7. The CA, with oversight by the TAB/CVA, retains the original non-conformance forms until the end of the project.

8. Any required retesting by any Contractor shall not be considered a justified reason for a claim of delay or for a time extension by the Contractor.

C. Failure Due to Manufacturer Defect: If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the Owner. In such case, the Contractor shall provide the Owner with the following:

1. Within one week of notification from the A/E, the Contractor shall examine all other identical units making a record of the findings. The findings shall be provided to the A/E within two weeks of the original notice.
2. Within two weeks of the original notification, the Contractor shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions, which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
3. The A/E will determine whether a replacement of all identical units or a repair is acceptable.
4. Two examples of the proposed solution will be installed by the Contractor and the CA will be allowed to test the installations for up to one week, upon which the CA will decide whether to accept the solution with oversight by the TAB/CVA
5. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

D. Approval: The CA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CA. The CA recommends acceptance of each test to the Owner and A/E using a standard form. The A/E gives final approval on each test using the same form, providing a signed copy to the CA and the Contractor.

3.6 OPERATION AND MAINTENANCE MANUALS

A. O&M Manuals: Specific content and format requirements for the O&M manuals are detailed in Section 017700 and Sections of Divisions 23, 26, 27 and 28. This Section 019113 also specifies some of the O&M manual contents. The O&M manuals are the responsibility of the contractor.

3.7 TRAINING OF OWNER PERSONNEL

A. The Contractor shall be responsible for coordinating and scheduling training of Owner's personnel for the equipment and systems installed by the Contractor, and ultimately for ensuring that training is completed.

B. The CA shall be responsible for overseeing and reviewing the content and adequacy of the training of Owner personnel for commissioned equipment.

1. The CA shall interview the facility manager and lead engineer to determine the special needs and areas where training will be most valuable. The Owner and CA shall decide how rigorous the training should be for each piece of commissioned equipment. The CA shall communicate the results to the Contractor and vendors who have training responsibilities.
2. In addition to these general requirements, the specific training requirements of Owner personnel by Contractor and vendors is specified in Divisions 23, 26, 27 and 28.
3. Each Contractor and vendor responsible for training will submit a written training plan to the CA for review and approval prior to training. The plan will cover the following elements:

   a. Equipment (included in training)
   b. Intended audience
   c. Location of training
   d. Objectives
   e. Subjects covered (description, duration of discussion, special methods, etc.)

f. Duration of training on each subject
g. Instructor for each subject
h. Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)
i. Instructor and qualifications

4. For the primary HVAC equipment, the ATCC shall provide a short discussion of the control of the equipment during the mechanical or electrical training conducted by others.
5. The CA develops an overall training plan and coordinates and schedules, with the Owner, TAB/CVA, and Contractor, the overall training for the commissioned systems. The CA, with oversight by the TAB/CVA, develops criteria for determining that the training was satisfactorily completed, including attending some of the training, etc. The TAB/CVA recommends approval of the training to the A/E using a standard form. The A/E also signs the approval form.
6. At one of the training sessions, the CA will discuss the use of the blank functional test forms for re-commissioning equipment.
7. The Contractor shall provide digital video-recording with audio of his training sessions for Owner's personnel and submit three copies on a common format disk media, appropriately cataloged and added to the O&M manuals.
8. Subject to Owner's authorization for additional A/E services, the design engineers will at the first training session present the overall system design concepts and the design concepts of each equipment section. This presentation will review all systems, using simplified system schematics (one-line drawings), including chilled water systems, heat rejection systems, heating systems, and gas supply systems, supply air systems, exhaust system and outside air strategies.

3.8 DEFERRED TESTING

A. Unforeseen Deferred Tests: If any check or test cannot be completed due to a deficiency in the building structure or other required occupancy condition, execution of checklists and functional testing may be delayed upon approval of the A/E.

1. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.

B. Seasonal Testing: During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) shall be completed as part of this Contract. The CA shall coordinate this activity with oversight by the TAB/CVA. Tests shall be executed, documented and deficiencies corrected by the appropriate Contractor, with Owner's facilities staff and the TAB/CVA and CA witnessing. Any final adjustments to the O&M manuals and as-builts due to the testing shall be made.

3.9 WRITTEN WORK PRODUCTS

A. The commissioning process generates a number of written work products described in various parts of the Specifications. The Commissioning Plan lists all the formal written work products, briefly describes their contents, who is responsible to create them, their due dates, who receives and approves them and the location of the specification to create them. In summary, the written products are:

Product	**Developed By**	**Reviewed/Modified & Approved By**
Commissioning plan	CA who is contractor who provides equipment	TAB/CVA, CM, A/E
Commissioning meeting minutes	TAB/CVA	CM, A/E, Owner
Commissioning schedules	CA with Contractors; GC incorporates in Project Construction Schedule	TAB/CVA, CM, A/E
Equipment documentation submittals	Contractors through CA	TAB/CVA, CM, A/E
Sequence clarifications	Contractors and A/E as needed	TAB/CVA, CM, A/E
Construction checklists	CA (Preliminary in Spec. Revised based on Approved Submittals)	TAB/CVA
Startup and initial checkout plan	Contractors and CA (Compilation of existing documents)	TAB/CVA

Product	Developed By	Reviewed/Modified & Approved By
Startup and initial checkout forms filled out	Contractors	TAB/CVA
Final TAB/CVA report	TAB/CVA	TAB/CVA, CM, A/E
Issues log (deficiencies)	CA with responses provided by Contractors	TAB/CVA, CM, A/E
Commissioning Progress Record	CA	TAB/CVA, CM, A/E
Deficiency reports	CA	TAB/CVA, CM, A/E
Functional test forms	CA	TAB/CVA, CM, A/E
Filled out functional tests	CA	TAB/CVA, CM, A/E
O&M manuals	Contractors; review by CA	TAB/CVA, CM, A/E
Commissioning record books & Compact Disks	CA	TAB/CVA, CM, A/E
Overall training plan	CA and Contractors	TAB/CVA, CM, A/E
Specific training agendas	CA and Contractors	TAB/CVA, CM, A/E
Final commissioning report	CA	TAB/CVA
Misc. approvals	CA	TAB/CVA

END OF SECTION 01 91 13

MAROTTA/MAIN
ARCHITECTS

PROJECT MANUAL

VOLUME 2 OF 3 – TECHNICAL SPECIFICATIONS

CHANCELLOR CENTER RENOVATIONS
30 N Chancellor Street
Newtown, PA 18940

for

COUNCIL ROCK SCHOOL DISTRICT
30 N Chancellor Street
Newtown, PA 18940

BID SET
OCTOBER 13, 2026

TECHNICAL SPECIFICATION INDEX

CHANCELLOR CENTER RENOVATIONS

COUNCIL ROCK SCHOOL DISTRICT

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END OF SPECIFICATION INDEX

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 01 10 00 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 01 56 39 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
3. Section 01 73 00 "Execution" for cutting and patching procedures.
4. Section 31 10 00 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse .

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site .

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property , for environmental protection , for dust control and , for noise control. Indicate proposed locations and construction of barriers.

C. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 01 32 33 "Photographic Documentation." Submit before Work begins.

E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.9 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before selective demolition, Owner will remove the following items:

a. Wireless access points and cameras
b. Furniture and miscellaneous wall-hangings/pictures.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Hazardous Materials: Present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Hazardous material remediation is specified elsewhere in the Contract Documents.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
3. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.

F. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by 12 inches(300 mm) or more.

G. Storage or sale of removed items or materials on-site is not permitted.

H. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video .

1. Comply with requirements specified in Section 01 32 33 "Photographic Documentation."
2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Arrange to shut off utilities with utility companies.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 "Temporary Facilities and Controls."

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and for at least 12 hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Dispose of demolished items and materials promptly. Comply with requirements in Section 01 74 19 "Construction Waste Management and Disposal."

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Work in Historic Areas: Selective demolition may be performed only in areas of Project that are not designated as historic. In historic spaces, areas, and rooms, or on historic surfaces, the terms "demolish" or "remove" shall mean historic "removal" or "dismantling" as specified in Section 02 42 96 "Historic Removal and Dismantling."

D. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

E. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

F. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

F. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section 07 54 16 Ketone Ethylene Ester (KEE) Roofing) for new roofing requirements.

1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction. and recycle or dispose of them according to Section 01 74 19 "Construction Waste Management and Disposal."

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.8 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 41 19

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 31 20 00 "Earth Moving" for drainage fill under slabs-on-ground.
2. Section 32 13 13 "Concrete Paving" for concrete pavement and walks.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete Subcontractor.
e. Special concrete finish Subcontractor.

2. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.
b. Construction joints, control joints, isolation joints, and joint-filler strips.
c. Semirigid joint fillers.
d. Vapor-retarder installation.
e. Anchor rod and anchorage device installation tolerances.
f. Cold and hot weather concreting procedures.
g. Concrete finishes and finishing.
h. Curing procedures.
i. Forms and form-removal limitations.
j. Shoring and reshoring procedures.
k. Methods for achieving specified floor and slab flatness and levelness.
l. Floor and slab flatness and levelness measurements.
m. Concrete repair procedures.
n. Concrete protection.

o. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
p. Protection of field cured field test cylinders.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Aggregates.
5. Admixtures:

a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

6. Color pigments.
7. Vapor retarders.
8. Floor and slab treatments.
9. Liquid floor treatments.
10. Curing materials.

a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.

11. Joint fillers.
12. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Calculated equilibrium unit weight, for lightweight concrete.
6. Slump limit.
7. Air content.
8. Nominal maximum aggregate size.
9. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
10. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
11. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
12. Intended placement method.
13. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

a. Location of construction joints is subject to approval of the Architect.

2. Reinforcing steel shop drawings.

D. Samples: For manufacturer's standard colors for color pigment.

E. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.
7. Floor treatment if any.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Ready-mixed concrete manufacturer.
3. Testing agency: Include copies of applicable ACI certificates.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Curing compounds.
4. Floor and slab treatments.
5. Bonding agents.
6. Adhesives.
7. Vapor retarders.
8. Semirigid joint filler.
9. Joint-filler strips.
10. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Silica fume.
6. Performance-based hydraulic cement.
7. Aggregates.
8. Admixtures:

a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.

D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.

E. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.

F. Preconstruction Test Reports: For each mix design.

G. Field quality-control reports.

H. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician.

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.

1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Field Quality Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.

1. Include the following information in each test report:

a. Admixture dosage rates.
b. Slump.
c. Air content.
d. Seven-day compressive strength.
e. 28-day compressive strength.
f. Permeability.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301 (ACI 301M).

1.10 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 306.1 and as follows.

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F (1.7 deg C), other than reinforcing steel.

5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M), and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F (35 deg C).
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

B. Plywood, metal, or other approved panel materials.

C. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

D. Forms for Curbing: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

F. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

G. Formulate form-release agent with rust inhibitor for steel form-facing materials.

H. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

I. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.

J. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.

K. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 (ACI 301M) unless modified by requirements in the Contract Documents.

2.3 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I, gray.
2. Fly Ash: ASTM C618, Class C or F.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

C. Normal-Weight Aggregates: ASTM C33/C33M coarse aggregate or better, graded. Provide aggregates from a single source.

1. Alkali-Silica Reaction: Comply with one of the following:

   a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
   b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
   c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. (2.37 kg/cu. m) for moderately reactive aggregate or 3 lb./cu. yd. (1.78 kg/cu. m) for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301 (ACI 301M).

2. Maximum Coarse-Aggregate Size: 3/4 inch (19 mm) nominal.
3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Lightweight Aggregate: ASTM C330/C330M, 3/4-inch (19-mm) nominal maximum aggregate size.

E. Air-Entraining Admixture: ASTM C260/C260M.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
7. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494/C494M, Type C.
8. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
9. Permeability-Reducing Admixture: ASTM C494/C494M, Type S, hydrophilic, permeability-reducing crystalline admixture, capable of reducing water absorption of concrete exposed to hydrostatic pressure (PRAH).

   a. Permeability: No leakage when tested in accordance with U.S. Army Corps of Engineers CRC C48 at a hydraulic pressure of 200 psi (1.28 MPa) for 14 days.

G. Water and Water Used to Make Ice: ASTM C94/C94M, potable.

2.4 VAPOR RETARDERS

A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.5 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete.

2.6 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

D. Water: Potable or complying with ASTM C1602/C1602M.

E. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

F. Clear, Waterborne, Membrane-Forming, Nondissipating Curing Compound: ASTM C309, Type 1, Class B, certified by curing compound manufacturer to not interfere with bonding of floor covering.

G. Clear, Waterborne, Membrane-Forming, Curing Compound: ASTM C309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

H. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

I. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

2.7 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 in accordance with ASTM D2240.

C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:

1. Types I and II, nonload bearing or Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.8 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.

2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand, as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested in accordance with ASTM C109/C109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested in accordance with ASTM C109/C109M.

2.9 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301 (ACI 301M).

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Other Pozzolans: 25 percent by mass.
2. Slag Cement: 50 percent by mass.
3. Silica Fume: 10 percent by mass.
4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for parking structure slabs, and concrete with a w/cm below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
5. Use permeability-reducing admixture in concrete mixtures where indicated.

D. Color Pigment: Add color pigment to concrete mixture in accordance with manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.10 CONCRETE MIXTURES

A. Normal-weight concrete used for footings.

1. Minimum Compressive Strength: 3000 psi (20.7 MPa) at 28 days.
2. Maximum w/cm: 0.50.
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
4. Air Content: N/A

B. Normal-weight concrete used for foundation walls and piers.

1. Minimum Compressive Strength: 4500 psi (27.6 MPa) at 28 days.
2. Maximum w/cm: 0.50.
3. Slump Limit: 4 inches (100 mm) , plus or minus 1 inch (25 mm).
4. Air Content:

a. 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch (19-mm) nominal maximum aggregate size.

C. Normal-weight concrete used for interior slabs-on-ground.

1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
2. Slump Limit: 4 inches (100 mm) , plus or minus 1 inch (25 mm).
3. Air Content:

a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

D. Normal-weight concrete used for interior suspended slabs.

1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
2. Maximum w/cm: 0.50.
3. Slump Limit: 4 inches (100 mm) , plus or minus 1 inch (25 mm).
4. Air Content:

a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

E. Normal-weight concrete used for exterior retaining walls.

1. Minimum Compressive Strength: 4500 psi (27.6 MPa) at 28 days.
2. Maximum w/cm: 0.50.
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
4. Air Content:

a. 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch (19-mm) nominal maximum aggregate size.

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and furnish batch ticket information.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.4 INSTALLATION OF VAPOR RETARDER

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
2. Face laps away from exposed direction of concrete pour.
3. Lap vapor retarder over footings and grade beams not less than 6 inches (150 mm), sealing vapor retarder to concrete.
4. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.
5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
7. Protect vapor retarder during placement of reinforcement and concrete.

a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches (150 mm) on all sides, and sealing to vapor retarder.

3.5 JOINTS

A. Construct joints true to line, with faces perpendicular to surface plane of concrete.

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.

2. Place joints perpendicular to main reinforcement.

    a. Continue reinforcement across construction joints unless otherwise indicated.
    b. Do not continue reinforcement through sides of strip placements of floors and slabs.

3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface, where joint sealants, specified in Section 07 92 00 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M), but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301 (ACI 301M).

    a. Do not use vibrators to transport concrete inside forms.
    b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer.
    c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Do not place concrete floors and slabs in a checkerboard sequence.
2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Maintain reinforcement in position on chairs during concrete placement.
4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.7 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 (ACI 301M) Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

    a. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.
    b. Remove projections larger than 1/4 inch (6 mm).
    c. Patch tie holes.
    d. Surface Tolerance: ACI 117 (ACI 117M) Class B.
    e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

B. Related Unformed Surfaces:
1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches (100 mm) high unless otherwise indicated on Drawings, and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.

    a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    b. Cast anchor-bolt insert into bases.
    c. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.9 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 (ACI 301M) and ACI 306.1 for cold weather protection during curing.
2. Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M) for hot-weather protection during curing.
3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h (1 kg/sq. m x h), calculated in accordance with ACI 305.1,) before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

    a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
    b. Continuous Sprinkling: Maintain concrete surface continuously wet.
    c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
    d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
    e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

1) Recoat areas subject to heavy rainfall within three hours after initial application.
2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:

1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:

a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12-inches (300-mm).
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive.

a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
b) Cure for not less than seven days.

3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12 inches (300 mm).
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive.

a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
b) Cure for not less than seven days.

3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

c. Floors to Receive Polished Finish: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12 inches (300 mm).
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

d. Floors to Receive Chemical Stain:

1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.
2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
3) Butt sides of curing paper tight; do not overlap sides of curing paper.
4) Leave curing paper in place for duration of curing period, but not less than 28 days.

e. Floors to Receive Urethane Flooring:

1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped 6 inches (150 mm) and sealed in place.
3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.

f. Floors to Receive Curing Compound:

1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Maintain continuity of coating, and repair damage during curing period.
4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

g. Floors to Receive Curing and Sealing Compound:

1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.10 TOLERANCES

A. Conform to ACI 117 (ACI 117M).

3.11 APPLICATION OF LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.

2. Do not apply to concrete that is less than three days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
4. Rinse with water; remove excess material until surface is dry.
5. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.12 JOINT FILLING

A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month(s).
2. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints.

D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.13 CONCRETE SURFACE REPAIRS

A. Defective Concrete:

1. Repair and patch defective areas when approved by Architect.
2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete.

   a. Limit cut depth to 3/4 inch (19 mm).
   b. Make edges of cuts perpendicular to concrete surface.
   c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
   d. Fill and compact with patching mortar before bonding agent has dried.
   e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.

   a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
   b. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.

a. Correct low and high areas.
b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.

   a. Finish repaired areas to blend into adjacent concrete.

5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.

   a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
   b. Feather edges to match adjacent floor elevations.

6. Correct other low areas scheduled to remain exposed with repair topping.

   a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations.
   b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

7. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete.

   a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around.
   b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
   c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
   d. Place, compact, and finish to blend with adjacent finished concrete.
   e. Cure in same manner as adjacent concrete.

8. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar.

   a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
   b. Dampen cleaned concrete surfaces and apply bonding agent.
   c. Place patching mortar before bonding agent has dried.
   d. Compact patching mortar and finish to match adjacent concrete.
   e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.14 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.

2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

    a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:

        1) Project name.
        2) Name of testing agency.
        3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
        4) Name of concrete manufacturer.
        5) Date and time of inspection, sampling, and field testing.
        6) Date and time of concrete placement.
        7) Location in Work of concrete represented by samples.
        8) Date and time sample was obtained.
        9) Truck and batch ticket numbers.
        10) Design compressive strength at 28 days.
        11) Concrete mixture designation, proportions, and materials.
        12) Field test results.
        13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
        14) Type of fracture and compressive break strengths at seven days and 28 days.

C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

D. Inspections:

1. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.
5. Verification of concrete strength before removal of shores and forms from beams and slabs.
6. Batch Plant Inspections: On a random basis, as determined by Architect.

E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
    a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M:

    a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    b. Perform additional tests when concrete consistency appears to change.

3. Slump Flow: ASTM C1611/C1611M:

    a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    b. Perform additional tests when concrete consistency appears to change.

4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; ASTM C173/C173M volumetric method, for structural lightweight concrete.

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

5. Concrete Temperature: ASTM C1064/C1064M:

    a. One test hourly when air temperature is 40 deg F (4.4 deg C) and below or 80 deg F (27 deg C) and above, and one test for each composite sample.

6. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

7. Compression Test Specimens: ASTM C31/C31M:

    a. Cast, initial cure, and field cure two sets of four standard cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C39/C39M.

    a. Test one set of four field-cured specimens at seven days and one set of two specimens at 28 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa) if specified compressive strength is 5000 psi (34.5 MPa), or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi (34.5 MPa).
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests:

    a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
    b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.

        1) Acceptance criteria for concrete strength shall be in accordance with ACI 301 ((ACI 301M),) section 1.6.6.3.

13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 (ASTM E1155M) within 48 hours of completion of floor finishing and promptly report test results to Architect.

3.15 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 03 30 00

SECTION 03 54 16 - HYDRAULIC CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes polymer-modified, self-leveling, hydraulic cement underlayment for application below interior floor coverings.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Hydraulic cement underlayment.
2. Reinforcement.
3. Primer.
4. Corrosion-resistant coating.
5. Surface sealer.

B. Shop Drawings: Include plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: Signed by manufacturers of underlayment and floor-covering systems certifying that products are compatible.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.

B. Product Certificates: Signed by manufacturers of underlayment and floor-covering systems certifying that products are compatible.

C. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

B. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.

1. Place hydraulic cement underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F outside conditions (10 and 27 deg C).

PART 2 - PRODUCTS

2.1 HYDRAULIC CEMENT UNDERLAYMENTS

A. Hydraulic Cement Underlayment: Polymer-modified, self-leveling, hydraulic cement product that can be applied in minimum uniform thickness of 1/4 inch (6 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Basis-of-Design Product: Subject to compliance with requirements, provide ARDEX Americas; ARDEX V 1200™ Self-Leveling Underlayment ; or comparable product by one of the following:

a. Laticrete International, Inc.
b. Uzin Utz North America, Inc.
c. The Euclid Chemical Company; a subsidiary of RPM International, Inc.

2. Cement Binder: ASTM C150/C150M, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C219.
3. Compressive Strength: Not less than 4500 psi (31.02 MPa) at 28 days when tested according to ASTM C109/C109M.
4. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer, formulated for use with underlayment when applied to substrate and conditions indicated.

B. Aggregate: Well-graded, washed dry gravel, 3/8 inch (3 to 6 mm); as recommended by underlayment manufacturer.

1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.

C. Water: Potable and at a temperature of not more than 70 deg F (21 deg C).

D. Reinforcement: For underlayment applied to wood substrates, provide galvanized metal lath or other corrosion-resistant reinforcement recommended in writing by underlayment manufacturer.

E. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

F. Corrosion-Resistant Coating: Recommended in writing by underlayment manufacturer for metal substrates.

G. Surface Sealer: Designed to reduce porosity as recommended by the manufacturer for type of floor covering to be applied to underlayment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for conditions affecting performance of the Work.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare and clean substrate according to manufacturer's written instructions.
1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
2. Fill substrate voids to prevent underlayment from leaking.

B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.

1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum percent relative humidity level measurement as required for the specified finish product, or as recommended by hydraulic cement underlayment manufacturer.

    b. Plastic Sheet Method Test, Standard Test Method for Indicating Moisture, ASTM D4263-83 (2018). Capillary moisture in the concrete may be detrimental to the performance of certain coating systems that cannot tolerate moisture on or within the surface boundary. This test method is used prior to the application of coatings on concrete.

        1) This test method is used to indicate the presence of capillary moisture in concrete.
        2) The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.
        3) This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use. For specific caution statements, see Section 4.
        4) This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

C. Wood Substrates: Mechanically fasten loose boards and panels to eliminate substrate movement and squeaks. Sand to remove coatings that might impair underlayment bond and remove sanding dust.

    a. Install underlayment reinforcement recommended in writing by manufacturer.

D. Metal Substrates: Mechanically remove, according to manufacturer's written instructions, rust, foreign matter, and other contaminants that might impair underlayment bond. Apply corrosion-resistant coating compatible with underlayment if recommended in writing by underlayment manufacturer.

E. Nonporous Substrates: For ceramic tile, quarry tile, and terrazzo substrates, remove waxes, sealants, and other contaminants that might impair underlayment bond, and prepare surfaces according to manufacturer's written instructions.

F. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

3.3 INSTALLATION

A. Mix and install underlayment components according to manufacturer's written instructions.

    1. Close areas to traffic during underlayment installation and for time period after installation recommended in writing by manufacturer.
    2. Coordinate installation of components to provide optimum adhesion to substrate and between coats.
    3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Install underlayment to produce uniform, level surface.
    1. Feather edges to match adjacent floor elevations.

D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during installation and curing processes.

E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.

F. Apply surface sealer at rate recommended by manufacturer.

G. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 INSTALLATION TOLERANCES

A. Finish and measure surface, so gap at any point between gypsum cement underlayment surface and an unleveled, freestanding, 10-foot- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/16 inch (1.6 mm) in 2 feet (610 mm).

3.5 PROTECTION

A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION 03 54 16

SECTION 04 03 10 - HISTORIC MASONRY CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes historic treatment work consisting of cleaning historic stone masonry and unit masonry surfaces

B. Related Requirements:

1. Section 01 35 91 "Historic Treatment Procedures" for general historic treatment requirements.

1.3 ALLOWANCES

A. Allowances for cleaning historic masonry are specified in Section 012100 "Allowances."

1. Quantities for base bid are shown on the drawings.
2. Perform historic masonry cleaning work under quantity allowances and only as authorized. Authorized work includes work required by Drawings and the Specifications and work as directed in writing by Architect.
3. Perform work that exceeds quantity allowances only as authorized by Change Orders.

B. Preconstruction testing is part of testing and inspecting allowance.

C. Cleaning brickwork and stone, including preliminary and final cleaning, is part of masonry cleaning allowance.

1.4 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1. Unit prices apply to authorized work covered by quantity allowances.
2. Unit prices apply to additions to and deletions from Work as authorized by Change Orders.

1.5 DEFINITIONS

A. Very Low-Pressure Spray: Less than 100 psi.

B. Low-Pressure Spray:

1. Pressure: 100 to 400 psi.
2. Flow Rate: 4 to 6 gpm.

C. Medium-Pressure Spray:

1. Pressure: 400 to 800 psi.
2. Flow Rate: 4 to 6 gpm.

D. High-Pressure Spray:

1. Pressure: 800 to 1200 psi.
2. Flow Rate: 4 to 6 gpm.

1.6 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to masonry historic treatment and cleaning.
2. Review methods and procedures related to cleaning historic masonry, including, but not limited to, the following:

a. Historic treatment specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
b. Materials, material application, and sequencing.
c. Quality-control program.
d. Fire-protection plan.
e. Cleaning program.
f. Coordination with building occupants.

1.7 SEQUENCING AND SCHEDULING

A. Work Sequence: Perform historic masonry cleaning work in the following sequence:

1. Remove plant growth.
2. Inspect masonry for open mortar joints. Where repairs are required, delay further cleaning work until after repairs are completed, cured, and dried to prevent intrusion of water and other cleaning materials into the wall.
3. Remove paint.
4. Clean masonry.
5. Where water repellents or graffiti-resistant coatings are to be used on or near masonry work, delay application of these chemicals until after cleaning.

B. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in masonry units in accordance with historic masonry repair Sections. Patch holes in mortar joints in accordance with historic masonry repointing Sections.

1.8 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include material descriptions and application instructions.
2. Include test data substantiating that products comply with requirements.

1.9 INFORMATIONAL SUBMITTALS

A. Qualification Data: For historic treatment specialists including field supervisors and workers paint-remover manufacturer and chemical-cleaner manufacturer.

B. Preconstruction Test Reports: For cleaning materials and methods.

C. Quality-control program.

D. Cleaning program.

1.10 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic masonry cleaning specialist. Experience cleaning new masonry work is insufficient experience for historic treatment work.

B. Paint-Remover Manufacturer Qualifications: A firm regularly engaged in producing masonry paint removers that have been used for similar applications with successful results, and with factory-authorized service

representatives who are available for consultation and Project-site inspection, preconstruction product testing, and on-site assistance.

C. Chemical-Cleaner Manufacturer Qualifications: A firm regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection, preconstruction product testing, and on-site assistance.

D. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising performance and preventing damage.

E. Cleaning Program: Prepare a written cleaning program that describes cleaning process in detail, including materials, methods, sequence, and equipment to be used; protection of surrounding materials; and control of runoff during operations.

1. If materials and methods other than those indicated are proposed for any phase of cleaning work, add to the quality-control program a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project.

F. Mockups: Prepare mockups of cleaning on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Cleaning: Clean an area approximately 25 sq. ft. for each type of masonry and surface condition.

a. Test cleaners and methods on samples of adjacent materials for possible adverse reactions. Do not test cleaners and methods known to have deleterious effect.
b. Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.11 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified historic treatment specialist or one or more chemical-cleaner and paint remover manufacturers to perform preconstruction testing on masonry surfaces.

1. Use test areas as indicated and representative of proposed materials and existing construction.
2. Propose changes to materials and methods to suit Project.

1.12 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit masonry cleaning work to be performed in accordance with product manufacturers' written instructions and specified requirements.

B. Clean masonry surfaces only when air temperature is 40 deg F and above and is predicted to remain so for at least seven days after completion of cleaning.

PART 2 - PRODUCTS

2.1 PAINT REMOVERS

A. Alkaline Paste Paint Remover: Manufacturer's standard alkaline paste or gel formulation for removing paint from masonry; containing no methylene chloride.

B. Covered or Skin-Forming Alkaline Paint Remover: Manufacturer's standard covered or skin-forming, alkaline paste or gel formulation for removing paint from masonry; containing no methylene chloride.

C. Solvent-Type Paste Paint Remover: Manufacturer's standard water-rinsable, solvent-type paste or gel formulation for removing paint from masonry.

D. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinsable, solvent-type paste, gel, or foamed emulsion formulation for removing paint from masonry; containing no methanol or methylene chloride.

E. Covered, Solvent-Type Paste Paint Remover: Manufacturer's standard, low-odor, covered, water-rinsable, solvent-type paste or gel formulation for removing paint from masonry; containing no methanol or methylene chloride.

2.2 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F.

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 1/2 cup of laundry detergent, and 20 quarts of hot water for every 5 gal. of solution required.

D. Mold, Mildew, and Algae Remover, Job Mixed: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 5 quarts of 5 percent sodium hypochlorite (bleach), and 15 quarts of hot water for every 5 gal. of solution required.

E. Nonacidic Gel Cleaner: Manufacturer's standard gel formulation, with pH between 6 and 9, that contains detergents with chelating agents and is specifically formulated for cleaning masonry surfaces.

F. Nonacidic Liquid Cleaner: Manufacturer's standard mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including polished stone, brick, aluminum, plastics, and wood.

G. Nonacidic Liquid Cleaner: Manufacturer's standard mildly alkaline liquid cleaner formulated for removing efflorescence, mortar smears, grout haze, hard water deposits, atmospheric staining, and other blemishes on the surface of masonry.

H. Mild-Acid Cleaner: Manufacturer's standard mild-acid cleaner based on phosphoric, oxalic, or citric acid; but not containing muriatic (hydrochloric), hydrofluoric, or sulfuric acid; or ammonium bifluoride or chlorine bleaches.

I. Acidic Cleaner: Manufacturer's standard acidic masonry cleaner composed of hydrofluoric acid or ammonium bifluoride blended with other acids, detergents, wetting agents, and inhibitors.

J. One-Part Limestone Acidic Cleaner: Manufacturer's standard one-part acidic formulation for cleaning limestone.

K. One-Part Limestone Nonacidic Cleaner: Manufacturer's standard one-part nonacidic formulation for cleaning limestone.

L. Two-Part Chemical Cleaner: Manufacturer's standard system consisting of potassium- or sodium-hydroxide-based, alkaline prewash cleaner and acidic afterwash cleaner that does not contain hydrofluoric acid.

2.3 ACCESSORY MATERIALS

A. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, glazed masonry, and polished stone surfaces from damaging effects of acidic and alkaline masonry cleaners.

B. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.
2. Minimal possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could do the following:

a. Remove, alter, or harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in contract.
b. Leave residue on surfaces.

2.4 CHEMICAL-CLEANING SOLUTIONS

A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical-cleaner manufacturer.

B. Acidic Cleaner Solution for Brick and Unpolished Stone: Dilute acidic cleaner with water to produce hydrofluoric acid content of 3 percent or less, but not greater than that recommended in writing by chemical-cleaner manufacturer.

1. Stones: Use only on unpolished granite, unpolished dolomite marble, and siliceous sandstone.

C. Acidic Cleaner Solution for Polished Stone and Glazed Masonry: Dilute acidic cleaner with water to concentration demonstrated by testing that does not etch or otherwise damage glazed or polished surface, but not greater than that recommended in writing by chemical-cleaner manufacturer.

1. Stones: Use only on polished granite and polished dolomite marble.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT SPECIALIST

A. Historic Treatment Specialist Firms: Subject to compliance with requirements.

3.2 PROTECTION

A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent paint removers and chemical cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.

1. Cover adjacent surfaces with materials that are proven to resist paint removers and chemical cleaners used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents according to manufacturer's written instructions. Do not apply liquid strippable masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
2. Do not apply chemical solutions during winds of enough force to spread them to unprotected surfaces.
3. Neutralize alkaline and acid wastes before disposal.
4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

B. Remove gutters and downspouts and associated hardware adjacent to immediate work area and store during masonry cleaning. Reinstall when masonry cleaning is complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.3 CLEANING MASONRY, GENERAL

A. Have cleaning work performed only by qualified historic treatment specialist.

B. Cleaning Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 50 feet away by Architect.

C. Proceed with cleaning in an orderly manner; work from top to bottom of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.

D. Use only those cleaning methods indicated for each masonry material and location.

1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage masonry.

a. Equip units with pressure gauges.
b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
d. For high-pressure water-spray application, use fan-shaped spray that disperses water at an angle of at least 40 degrees.
e. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F at flow rates indicated.
f. For steam application, use steam generator capable of delivering live steam at nozzle.

E. Perform each cleaning method in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces.

1. Keep wall wet below area being cleaned to prevent streaking from runoff.

F. Perform additional general cleaning, paint and stain removal, and spot cleaning of small areas that are noticeably different when viewed in accordance with "Cleaning Appearance Standard" Paragraph, so that cleaned surfaces blend smoothly into surrounding areas.

G. Water-Spray Application Methods:

1. Water-Soak Application: Soak masonry surfaces by applying water continuously and uniformly to limited area for time indicated. Apply water at low pressures and low volumes in multiple fine sprays using perforated hoses or multiple spray nozzles. Erect a protective enclosure constructed of polyethylene sheeting to cover area being sprayed.
2. Water-Spray Applications: Unless otherwise indicated, hold spray nozzle at least 6 inches from masonry surface, and apply water in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.

H. Steam Cleaning: Apply steam to masonry surfaces at very low pressures indicated for each type of masonry. Hold nozzle at least 6 inches from masonry surface, and apply steam in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.

I. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces in accordance with chemical-cleaner manufacturer's written instructions; use brush or spray application. Do not spray apply at pressures exceeding 50 psi. Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

J. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.

1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.

K. After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

3.4 PRELIMINARY CLEANING

A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible before removal. Remove loose soil and plant debris from open masonry joints to whatever depth they occur.

B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, caulking, asphalt, and tar.

1. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.
2. Remove paint and caulking with alkaline paint remover.

a. Comply with requirements in "Paint Removal" Article.
b. Repeat application up to two times if needed.

3. Remove asphalt and tar with solvent-type paste paint remover.

a. Comply with requirements in "Paint Removal" Article.
b. Apply paint remover only to asphalt and tar by brush without prewetting.
c. Allow paint remover to remain on surface for 10 to 30 minutes.
d. Repeat application if needed.

3.5 PAINT REMOVAL

A. Paint-Remover Application, General: Apply paint removers in accordance with paint-remover manufacturer's written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

B. Paint Removal with Alkaline Paste Paint Remover:

1. Remove loose and peeling paint using low-pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with brushes.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Rinse with cold water applied by low-pressure spray to remove chemicals and paint residue.
5. Repeat process if necessary to remove all paint.
6. Apply acidic cleaner or manufacturer's recommended afterwash to surface, while surface is still wet, using low-pressure spray equipment or soft-fiber brush. Let cleaner or afterwash remain on surface as a neutralizing agent for period recommended in writing by chemical-cleaner or afterwash manufacturer.
7. Rinse with cold water applied by low-pressure spray to remove chemicals and soil.

C. Paint Removal with Covered or Skin-Forming Alkaline Paint Remover:

1. Remove loose and peeling paint using low-pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with trowel, spatula, or as recommended in writing by manufacturer.
3. Apply cover in accordance with manufacturer's written instructions.

4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
5. Scrape off paint and remover.
6. Rinse with cold water applied by low-pressure spray to remove chemicals and paint residue.
7. Apply acidic cleaner or manufacturer's recommended afterwash to surface, while surface is still wet, using low-pressure spray equipment or soft-fiber brush. Let cleaner or afterwash remain on surface as a neutralizing agent for period recommended in writing by chemical-cleaner or afterwash manufacturer.
8. Rinse with cold water applied by low-pressure spray to remove chemicals and soil.
9. For spots of remaining paint, apply alkaline paste paint remover in accordance with "Paint Removal with Alkaline Paste Paint Remover" Paragraph.

D. Paint Removal with Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using low-pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply thick coating of paint remover to painted surface with natural-fiber cleaning brush, deep-nap roller, or large paint brush. Apply in one or two coats in accordance with manufacturer's written instructions.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Rinse with cold water applied by low-pressure spray to remove chemicals and paint residue.

E. Paint Removal with Covered, Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using low-pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with trowel, spatula, or as recommended in writing by manufacturer.
3. Apply cover in accordance with manufacturer's written instructions.
4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
5. Scrape off paint and remover.
6. Rinse with cold water applied by low-pressure spray to remove chemicals and paint residue.

3.6 CLEANING MASONRY AND STONEWORK

A. Cold-Water Soak:

1. Apply cold water by intermittent spraying to keep surface moist.
2. Use perforated hoses or other means that apply a fine water mist to entire surface being cleaned.
3. Apply water in cycles of five minutes on and 20 minutes off.
4. Continue spraying until surface encrustation has softened enough to permit its removal by water wash, as indicated by cleaning tests.
5. Remove soil and softened surface encrustation from surface with cold water applied by low-pressure spray.

B. Cold-Water Wash: Use cold water applied by low-pressure spray.

C. Detergent Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. Rinse with cold water applied by low-pressure spray to remove detergent solution and soil.
4. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup.

D. Mold, Mildew, and Algae Removal:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply mold, mildew, and algae remover by brush or low-pressure spray.
3. Scrub surface with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that surface remains wet.
4. Rinse with cold water applied by low-pressure spray to remove mold, mildew, and algae remover and soil.
5. Repeat cleaning procedure, where needed to produce cleaning effect established by mockup.

3.7 FINAL CLEANING

A. Clean adjacent nonmasonry surfaces of spillage and debris. Use detergent and soft brushes or cloths.

B. Remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.

C. Remove masking materials, leaving no residues that could trap dirt.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.

B. Architect's Project Representatives: Architect will assign Project representatives to help carry out Architect's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Architect's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.

C. Notify inspectors and Architect's Project representatives in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until inspectors and Architect's Project representatives have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.

D. Manufacturer's Field Service: Engage paint-remover manufacturer's and chemical-cleaner manufacturer's factory-authorized service representatives for consultation and Project-site inspection, to perform preconstruction product testing, and provide on-site assistance when requested by Architect. Have paint-remover manufacturer's and chemical-cleaner manufacturer's factory-authorized service representatives visit Project site not less than once to observe progress and quality of the Work.

END OF SECTION 04 03 10

SECTION 04 03 20 - HISTORIC BRICK MASONRY REPAIR AND REPOINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes historic treatment work consisting of repairing historic clay brick masonry as follows:

1. Repairing brick masonry.
2. Removing abandoned anchors.
3. Painting steel uncovered during the work.
4. Reanchoring veneers.

B. Section includes historic treatment work consisting of repointing brick masonry as follows:

1. Repointing joints with mortar.
2. Repointing joints with sealant.
3. Widening joints.

C. Related Requirements:

1. Section 01 35 91 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 04 03 10 “Historic Masonry Cleaning” for masonry cleaning
3. Section 04 03 23 “Historic Brick Masonry Repointing” for masonry repointing.
4. Section 07 62 00 "Sheet Metal Flashing and Trim" for metal flashing installed in or on repaired masonry.
5. Section 07 92 00 “Joint Sealants.”

1.3 ALLOWANCES

A. Allowances for historic masonry repair are specified in Section 01 21 00 "Allowances."

1.4 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 01 22 00 "Unit Prices."

1. Unit prices apply to authorized work covered by quantity allowances.
2. Unit prices apply to additions to and deletions from Work as authorized by Change Orders.

1.5 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: 100 to 400 psi.
2. Flow Rate: 4 to 6 gpm.

B. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

C. Saturation Coefficient: Ratio of the weight of water absorbed during immersion in cold water to weight absorbed during immersion in boiling water; used as an indication of resistance of bricks to freezing and thawing.

1.6 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to masonry historic treatment and repair.
2. Review methods and procedures related to repairing historic brick masonry, including, but not limited to, the following:

a. Historic treatment specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
b. Materials, material application, sequencing, tolerances, and required clearances.
c. Quality-control program.
d. Fire-protection plan.
e. Unit masonry historic treatment program.
f. Coordination with building occupants.

1.7 SEQUENCING AND SCHEDULING

A. Order sand and gray portland cement for colored mortar immediately after approval of mockups. Take delivery of and store at Project site a sufficient quantity to complete Project.

B. Work Sequence: Perform masonry historic treatment work in the following sequence, which includes work specified in this and other Sections:

1. Remove plant growth.
2. Inspect masonry for open mortar joints and permanently or temporarily point them before cleaning to prevent intrusion of water and other cleaning materials into the wall.
3. Remove paint.
4. Clean masonry.
5. Rake out mortar from joints surrounding masonry to be replaced and from joints adjacent to masonry repairs along joints.
6. Repair masonry, including replacing existing masonry with new masonry materials.
7. Rake out mortar from joints to be repointed.
8. Point mortar and sealant joints.
9. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.
10. Where water repellents are to be used on or near masonry work, delay application of these chemicals until after pointing and cleaning.

C. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in bricks according to "Brick Masonry Patching" Article. Patch holes in mortar joints according to Section 04 03 23 "Historic Brick Unit Masonry Repointing."

1.8 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include recommendations for product application and use.
3. Include test data substantiating that products comply with requirements.

B. Shop Drawings:

1. Include plans, elevations, sections, and locations of masonry repair work on the structure.
2. Show full-size patterns with complete dimensions for new molded brick shapes and brick arches and their jointing, showing relationship of existing units to new units.
3. Show provisions for expansion joints or other sealant joints.
4. Show provisions for flashing, lighting fixtures, conduits, and weep holes as required.

5. Show replacement and repair anchors. Include details of anchors within individual bricks, with locations of anchors and dimensions of holes and recesses in units required for anchors.
6. Show locations of scaffolding and points of scaffolding in contact with masonry. Include details of each point of contact or anchorage.

C. Samples for Initial Selection: For the following:

1. Colored Mortar: Submit sets of mortar that will be left exposed in the form of sample mortar strips, 6 inches long by 1/4 inch wide, set in aluminum or plastic channels.

   a. Have each set contain a close color range of at least three Samples of different mixes of colored sands and cements that produce a mortar matching existing, cleaned mortar when cured and dry.
   b. Submit with precise measurements on ingredients, proportions, gradations, and sources of colored sands from which each Sample was made.

2. Sand Types Used for Mortar: Minimum 8 oz. of each in plastic screw-top jars.

   a. For blended sands, provide Samples of each component and blend. Identify blend ratio.
   b. Identify sources, both supplier and quarry, of each type of sand.

3. Patching Compound: Submit sets of patching compound Samples in the form of plugs (patches in drilled holes) in sample units of masonry representative of the range of masonry colors on the building.

   a. Have each set contain a close color range of at least three Samples of different mixes of patching compound that match the variations in existing masonry when cured and dry.

4. Sealant materials.

5. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For the following:

1. Each type of brick to be used for replacing existing units. Include sets of Samples to show the full range of shape, color, and texture to be expected.

   a. For each brick type, provide straps or panels containing at least four bricks. Include multiple straps for brick with a wide range.

2. Each type of patching compound in the form of briquettes, at least 3 inches long by 1-1/2 inches wide. Document each Sample with manufacturer and stock number or other information necessary to order additional material.
3. Each type, color, and texture of pointing mortar in the form of sample mortar strips, 6 inches long by 1/4 inch wide, set in aluminum or plastic channels.

   a. Include with each Sample a list of ingredients with proportions of each. Identify sources, both supplier and quarry, of each type of sand and brand names of cementitious materials and pigments if any.

4. Sealant materials.
5. Accessories: Each type of anchor, accessory, and miscellaneous support.

1.9 INFORMATIONAL SUBMITTALS

A. Qualification Data: For historic treatment specialist, including field supervisors and workers, and testing service.

B. Preconstruction Test Reports: For existing bricks and mortar and replacement bricks.

C. Quality-control program.

D. Unit masonry historic treatment program.

1.10 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic brick masonry repair and repointing specialist. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience installing standard unit masonry and in pointing or repointing only new or nonhistoric masonry is insufficient experience for masonry historic treatment work.

a. Field Supervision: Historic Treatment Specialist firm shall maintain experienced full-time supervisors on Project site during times that brick masonry repair and repointing work is in progress.
b. Historic Brick Masonry Repair Worker Qualifications: When bricks are being patched, assign at least one worker per crew who is trained and certified by manufacturer of patching compound to apply its products.

B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising worker performance and preventing damage.

C. Unit Masonry Historic Treatment Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for each phase of historic treatment work, including protection of surrounding materials and Project site.

1. Include methods for keeping exposed mortar damp during curing period.
2. If materials and methods other than those indicated are proposed for any phase of historic treatment work, add to the quality-control program a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project.

D. Mockups: Prepare mockups of historic treatment to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Masonry Repair: Prepare sample areas for each type of masonry material indicated to have repair work performed. If not otherwise indicated, size each mockup not smaller than two adjacent whole units or approximately 48 inches in least dimension. Construct sample areas in locations in existing walls where directed by Architect unless otherwise indicated. Demonstrate quality of materials, workmanship, and blending with existing work. Include the following as a minimum:

a. Replacement: Four brick units replaced.
b. Reanchoring Veneers: Install three masonry repair anchors in mockup wall assembly of each anchor type required.
c. Patching: Three small holes at least 1 inch in diameter for each type of brick indicated to be patched, so as to leave no evidence of repair.

2. Widening Joints: Widen a joint in two separate locations, each approximately 12 inches long.
3. Repointing: Rake out joints in two separate areas, each approximately 36 inches high by 48 inches wide for each type of repointing required, and repoint one of the areas.
4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.11 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on brick masonry as follows:

1. Provide test specimens as indicated and representative of proposed materials and existing construction.
2. Replacement Brick: Test each proposed type of replacement brick, according to sampling and testing methods in ASTM C67 for compressive strength, 24-hour cold-water absorption, five-hour boil absorption, saturation coefficient, and initial rate of absorption (suction).
3. Existing Brick: Test each type of existing brick indicated for replacement, according to testing methods in ASTM C67 for compressive strength, 24-hour cold-water absorption, five-hour boil absorption, saturation coefficient, and initial rate of absorption (suction). Carefully remove five existing units for testing from locations designated by Architect. Take testing samples from these units.
4. Existing Mortar: Test according to ASTM C1324, modified as agreed by testing service and Architect for Project requirements, to determine proportional composition of original ingredients, sizes and colors of aggregates, and approximate strength. Use X-ray diffraction, infrared spectroscopy, and differential thermal analysis to supplement microscopical methods. Carefully remove existing mortar for testing from within joints at five locations designated by Architect or testing service.
5. Temporary Patch: As directed by Architect, provide temporary materials followed by permanent repairs at locations from which existing samples were taken.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Deliver bricks to Project site strapped together in suitable packs or pallets or in heavy-duty cartons and protected against impact and chipping.

B. Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

D. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.

E. Store lime putty covered with water in sealed containers.

F. Store sand where grading and other required characteristics can be maintained and contamination avoided.

G. Handle bricks to prevent overstressing, chipping, defacement, and other damage.

1.13 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit repair work to be performed according to product manufacturers' written instructions and specified requirements.

B. Temperature Limits: Repair brick masonry only when air temperature is between 40 and 90 deg F and is predicted to remain so for at least seven days after completion of the Work unless otherwise indicated.

C. Cold-Weather Requirements: Comply with the following procedures for masonry repair unless otherwise indicated:

1. When air temperature is below 40 deg F, heat mortar ingredients, masonry repair materials, and existing masonry walls to produce temperatures between 40 and 120 deg F.
2. When mean daily air temperature is below 40 deg F, provide enclosure and heat to maintain temperatures above 32 deg F within the enclosure for seven days after repair.

D. Hot-Weather Requirements: Protect masonry repairs when temperature and humidity conditions produce excessive evaporation of water from mortar and repair materials. Provide artificial shade and wind breaks, and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with

temperatures of 90 deg F and above unless otherwise indicated.

E. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Source Limitations: Obtain each type of material for repairing historic masonry (face brick, cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 MASONRY MATERIALS

A. Salvaged Brick

B. Face Brick: Units, including molded, ground, cut, or sawed shapes as required to complete masonry repair work.

1. Brick Matching Existing: Units with colors, color variation within units, surface texture, size, and shape that match existing brickwork and with physical properties within 10 percent of those determined from preconstruction testing of selected existing units.

a. For existing brickwork that exhibits a range of colors or color variation within units, provide brick that proportionally matches that range and variation rather than brick that matches an individual color within that range.

2. Special Shapes:

a. Provide molded, 100 percent solid shapes for applications where core holes or "frogs" could be exposed to view or weather when in final position, and where shapes produced by sawing would result in sawed surfaces being exposed to view.
b. Provide specially ground units, shaped to match patterns, for arches and where indicated.
c. Mechanically chopping or breaking brick, or bonding pieces of brick together by adhesive, are unacceptable procedures for fabricating special shapes.

3. Tolerances as Fabricated: According to tolerance requirements in ASTM C216, Type FBX.

C. Building Brick: ASTM C62, of same vertical dimension as face brick, for masonry work concealed from view.

1. Grade SW where in contact with earth.
2. Grade SW, Grade MW, or Grade NW for concealed backup.

D. Salvaged Brick: Obtain salvaged brick from location indicated on Drawings. Clean off residual mortar.

2.3 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II; white, gray, or both where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Factory-Prepared Lime Putty: ASTM C1489.

D. Quicklime: ASTM C5, pulverized lime.

E. Mortar Sand: ASTM C144 unless otherwise indicated.

1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Colored Mortar: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
3. For exposed mortar, provide sand with rounded edges.

F. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

G. Water: ASTM C270, potable.

2.4 MANUFACTURED REPAIR MATERIALS

A. Brick Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching brick masonry.

1. Use formulation that is vapor and water permeable (equal to or more than the brick), exhibits low shrinkage, has lower modulus of elasticity than the bricks being repaired, and develops high bond strength to all types of masonry.
2. Use formulation having working qualities and retardation control to permit forming and sculpturing where necessary.
3. Formulate patching compound used for patching brick in colors and textures to match each unit being patched. Provide sufficient number of colors to enable matching the color, texture, and variation of each unit.

2.5 ACCESSORY MATERIALS

A. Masonry Repair Anchors, Expansion Type: Mechanical fasteners designed for masonry veneer stabilization consisting of 1/4-inch- diameter, Type 304 stainless-steel rod with brass expanding shells at each end and water-shedding washer in the middle. Expanding shells shall be designed to provide positive mechanical anchorage to veneer on one end and backup masonry on the other.

B. Masonry Repair Anchors, Spiral Type: Driven-in, Type 304 stainless-steel spiral rods designed to be installed in drilled holes and relying on screw effect rather than adhesive to secure them to backup and veneer. Anchors are flexible in plane of veneer but rigid perpendicular to it.

C. Masonry Repair Anchors, Expanding Grout Sleeve Type: Fabric sleeve system with Type 304 stainless-steel tube through which system manufacturer's grout is pumped to expand the sleeve, fill cavities within wall, and bond mechanically and chemically with interior of wall construction; and complete with other devices required for installation.

D. Setting Buttons and Shims: Resilient plastic, nonstaining to masonry, sized to suit joint thicknesses and bed depths of bricks, less the required depth of pointing materials unless removed before pointing.

E. Masking Tape: Nonstaining, nonabsorbent material; compatible with mortar, joint primers, sealants, and surfaces adjacent to joints; and that easily comes off entirely, including adhesive.

F. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer according to SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.

1. Surface Preparation: Use coating requiring no better than SSPC-SP 2, "Hand Tool Cleaning," surface preparation according to manufacturer's literature or certified statement.
2. VOC Limit: Use coating with a VOC content of 400 g/L or less.

G. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.

2. Minimal possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could do the following:

    a. Remove, alter, or harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in Contract.
    b. Leave residue on surfaces.

H. Sealant Materials:

1. Sealant manufacturer's standard elastomeric sealant(s) of base polymer and characteristics indicated below and according to applicable requirements in Section 079200 "Joint Sealants."

    a. Type: Single-component, nonsag urethane sealant.

2. Colors: Provide colors of exposed sealants to match colors of mortar adjoining installed sealant unless otherwise indicated.
3. Ground-Mortar Aggregate: Custom crushed and ground pointing mortar sand or existing mortar retrieved from joints. Grind to a particle size that matches the adjacent mortar aggregate and color. Remove all fines passing No. 100 sieve.

I. Joint-Sealant Backing:

1. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
2. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended in writing by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.6 MORTAR MIXES

A. Preparing Lime Putty: Slake quicklime and prepare lime putty according to appendix to ASTM C5 and manufacturer's written instructions.

B. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

C. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

D. Do not use admixtures in mortar unless otherwise indicated.

E. Mixes: Mix mortar materials in the following proportions:

1. Rebuilding (Setting) Mortar by Type: ASTM C270, Proportion Specification, Type O unless otherwise indicated; with cementitious material limited to portland cement and lime.
2. Colored Mortar: Add mortar pigments to produce exposed, setting (rebuilding) mortar of colors required.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT SPECIALIST

A. Historic Treatment Specialist Firms: Subject to compliance with requirements.

3.2 PROTECTION

A. Prevent mortar from staining face of surrounding masonry and other surfaces.

1. Cover sills, ledges, and other projecting items to protect them from mortar droppings.
2. Keep wall area wet below rebuilding and repair work to discourage mortar from adhering.
3. Immediately remove mortar splatters in contact with exposed masonry and other surfaces.

B. Remove gutters and downspouts and associated hardware adjacent to immediate work area, and store during masonry repair work. Reinstall when repairs are complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.3 MASONRY REPAIR, GENERAL

A. Have repair work performed only by qualified historic treatment specialist.

B. Repair Appearance Standard: Repaired surfaces are to have a uniform appearance as viewed from 50 feet away by Architect.

3.4 ABANDONED ANCHOR REMOVAL

A. Remove abandoned anchors, brackets, wood nailers, and other extraneous items no longer in use unless indicated to remain.

1. Remove items carefully to avoid spalling or cracking masonry.
2. Notify Architect before proceeding if an item cannot be removed without damaging surrounding masonry. Do the following where directed:

a. Cut or grind off item approximately 3/4 inch beneath surface, and core drill a recess of same depth in surrounding masonry as close around item as practicable.
b. Immediately paint exposed end of item with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended dry film thickness per coat. Keep paint off sides of recess.

3. Patch the hole where each item was removed unless directed to remove and replace brick.

3.5 BRICK REMOVAL AND REPLACEMENT

A. At locations indicated, remove bricks that are damaged, spalled, deteriorated, or are to be reused. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

1. When removing single bricks, remove material from center of brick and work toward outside edges.

B. Support and protect remaining masonry that surrounds removal area.

C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition. Coordinate with new flashing, reinforcement, and lintels, which are specified in other Sections.

D. Notify Architect of unforeseen detrimental conditions, including voids, cracks, bulges, loose masonry units in existing backup, rotted wood, rusted metal, and other deteriorated items.

E. Remove in an undamaged condition as many whole bricks as possible.

1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
3. Store brick for reuse. Store off ground, on skids, and protected from weather.
4. Deliver cleaned brick not required for reuse to Owner unless otherwise indicated.

F. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.

G. Replace removed damaged brick with other removed brick and salvaged brick in good condition, where possible, or with new brick matching existing brick. Do not use broken units unless they can be cut to usable size.

H. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

1. Maintain joint width for replacement units to match existing joints.
2. Use setting buttons or shims to set units accurately spaced with uniform joints.

I. Lay replacement brick with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min.. Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.

1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.
2. Rake out mortar used for laying brick before mortar sets according to Section 040323 "Historic Brick Unit Masonry Repointing." Point at same time as repointing of surrounding area.
3. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.

J. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.6 BACKUP MASONRY REMOVAL AND REPLACEMENT

A. Where backup masonry is fractured or unstable and at locations indicated, remove mortar and masonry units that are broken or deteriorated and rebuild with whole, new brick or whole salvaged backup masonry units. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

B. Support and protect remaining masonry that surrounds removal area.

C. Maintain flashing, reinforcement, anchors, lintels, and adjoining construction in an undamaged condition. Coordinate with new flashing, reinforcement, and lintels, which are specified in other Sections.

D. Notify Architect of unforeseen detrimental conditions, including voids, cracks, bulges, loose masonry units beyond the removal area, rotted wood, rusted metal, and other deteriorated items.

E. Remove in an undamaged condition as many whole bricks as possible.

1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
3. Store brick for reuse. Store off ground, on skids, and protected from weather.
4. Deliver cleaned brick not required for reuse to Owner unless otherwise indicated.

F. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.

G. Replace removed damaged brick with salvaged backup brick in good condition, where possible, or with new building brick matching existing backup brick. Do not use broken units unless they can be cut to usable size.

H. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

I. Lay replacement brick with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min.. Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.

J. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.7 REANCHORING VENEERS

A. Install masonry repair anchors in horizontal mortar joints and according to manufacturer's written instructions. Space anchors not more than 16 inches o.c. vertically and 24 inches o.c. horizontally apart unless otherwise indicated. Install at locations to avoid penetrating flashing.

B. Recess anchors 5/8 inch or more from surface of mortar joint, and fill recess with pointing mortar according to Section 040323 "Historic Brick Unit Masonry Repointing."

3.8 PAINTING STEEL UNCOVERED DURING THE WORK

A. Notify Architect if steel is exposed during masonry removal. Where Architect determines that steel is structural, or for other reasons cannot be totally removed, prepare and paint it as follows:

1. Surface Preparation: Remove paint, rust, and other contaminants according to SSPC-SP 2, "Hand Tool Cleaning," as applicable to comply with paint manufacturer's recommended preparation.
2. Antirust Coating: Immediately paint exposed steel with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended rate of application (dry film thickness per coat).

B. If on inspection and rust removal, the thickness of a steel member is found to be reduced from rust by more than 1/16 inch, notify Architect before proceeding.

3.9 BRICK MASONRY PATCHING

A. Patch the following bricks unless another type of repair or replacement is indicated:

1. Bricks indicated to be patched.
2. Bricks with holes.
3. Bricks with chipped edges or corners. Patch chipped edges or corners measuring more than 3/4 inch in least dimension.
4. Bricks with small areas of deep deterioration. Patch deep deteriorations measuring more than 3/4 inch in least dimension and more than 1/4 inch deep.

B. Remove and replace existing patches where indicated.

C. Patching Bricks:

1. Remove loose material from masonry surface. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least 1/4 inch thick, but not less than recommended in writing by patching compound manufacturer.
2. Mask adjacent mortar joint or rake out for repointing if patch extends to edge of brick.
3. Mix patching compound in individual batches to match each unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.
4. Rinse surface to be patched and leave damp, but without standing water.
5. Brush-coat surfaces with slurry coat of patching compound according to manufacturer's written instructions.
6. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch or more than 2 inches thick. Roughen surface of each layer to provide a key for next layer.
7. Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of the brick. Shape and finish surface before or after curing, as determined by testing, to best match existing brick.
8. Keep each layer damp for 72 hours or until patching compound has set.

3.10 MASONRY REPOINTING, GENERAL

A. Have repointing work performed only by qualified historic treatment specialist.

B. Appearance Standard: Repointed surfaces are to have a uniform appearance as viewed from 50 feet away by Architect.

3.11 WIDENING JOINTS

A. Do not widen a joint, except where indicated or approved by Architect.

B. Location Guideline: Where an existing brick abuts another or the joint is less than 1/8 inch, widen the joint for length indicated and to depth required for repointing after obtaining Architect's approval.

C. Carefully perform widening by using cutting, grinding, routing, or filing procedures demonstrated in an approved mockup.

D. Widen joint to width equal to or less than predominant width of other joints on building. Make sides of widened joint uniform and parallel. Ensure that edges of units along widened joint are in alignment with joint edges at unaltered joints.

3.12 REPOINTING

A. Rake out and repoint joints to the following extent:

1. All joints in areas indicated.
2. Joints indicated as sealant-filled joints.
3. Joints at locations of the following defects:

    a. Holes and missing mortar.
    b. Cracks that can be penetrated 1/4 inch or more by a knife blade 0.027 inch thick.
    c. Cracks 1/8 inch or more in width and of any depth.
    d. Hollow-sounding joints when tapped by metal object.
    e. Eroded surfaces 1/4 inch or more deep.
    f. Deterioration to point that mortar can be easily removed by hand, without tools.
    g. Joints filled with substances other than mortar.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of 2 times joint width and not less than that required to expose sound, unweathered mortar. Do not remove unsound mortar more than 2 inches deep; consult

Architect for direction.

2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of bricks or widen joints. Replace or patch damaged bricks as directed by Architect.

    a. Cut out mortar by hand with chisel and resilient mallet. Do not use power-operated grinders without Architect's written approval based on approved quality-control program.
    b. Cut out center of mortar bed joints using angle grinders with diamond-impregnated metal blades. Remove remaining mortar in bed joints and mortar in head joints by hand with chisel and resilient mallet. Strictly adhere to approved quality-control program.

D. Notify Architect of unforeseen detrimental conditions, including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 3/8 inch. Fully compact each layer and allow it to become thumbprint hard before applying next layer. Where existing brick have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

    a. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.
    b. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.

6. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Remove mortar and repoint.

F. Pointing with Sealant: Comply with Section 079200 "Joint Sealants" and as follows:

1. After raking out, keep joints dry and free of mortar and debris.
2. Clean and prepare joint surfaces. Prime joint surfaces unless sealant manufacturer recommends against priming. Do not allow primer to spill or migrate onto adjoining surfaces.
3. Fill sealant joints with specified joint sealant:

    a. Install cylindrical sealant backing beneath the sealant. Where space is insufficient for cylindrical sealant backing, install bond-breaker tape.
    b. Install sealant using only proven installation techniques that ensure that sealant is deposited in a uniform, continuous ribbon, without gaps or air pockets, and with complete wetting of the joint bond surfaces equally on both sides. Fill joint flush with surrounding masonry and matching the contour of adjoining mortar joints.
    c. Install sealant as recommended in writing by sealant manufacturer but within the following general limitations, measured at the center (thin) section of the bead:

        1) Fill joints to a depth equal to joint width, but not more than 1/2 inch deep or less than 1/4 inch deep.

d. Tool sealant to form smooth, uniform beads, slightly concave. Remove excess sealant from surfaces adjacent to joint.
e. Sanded Joints: Immediately after first tooling, apply ground-mortar aggregate to sealant, gently pushing aggregate into the surface of sealant. Lightly retool sealant to form smooth, uniform beads, slightly concave. Remove excess sealant and aggregate from surfaces adjacent to joint.
f. Do not allow sealant to overflow or spill onto adjoining surfaces, or to migrate into the voids of adjoining surfaces, particularly rough textures. Remove excess and spillage of sealant promptly as the work progresses. Clean adjoining surfaces by the means necessary to eliminate evidence of spillage, without damage to adjoining surfaces or finishes, as demonstrated in an approved mockup.

G. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.13 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

B. Clean adjacent nonmasonry surfaces. Use detergent and soft brushes or cloths.

C. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.

D. Remove masking materials, leaving no residues that could trap dirt.

3.14 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage qualified testing agencies to perform tests and inspections. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.

B. Architect's Project Representatives: Architect will assign Project representatives to help carry out Architect's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Architect's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.

C. Notify testing agency and Architect's Project representatives in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until inspectors and Architect's Project representatives have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.

3.15 MASONRY-WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property.

B. Masonry Waste: Remove masonry waste and legally dispose of off Owner's property.

END OF SECTION 04 03 20

SECTION 04 03 40 - HISTORIC STONE MASONRY REPAIR AND REPOINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes historic treatment work consisting of repairing historic stone assemblies as follows:

1. Repairing stone masonry.
2. Removing abandoned anchors.
3. Painting steel uncovered during the Work.

B. Section includes historic treatment work consisting of repointing stone masonry joints with mortar and sealant.

C. Related Requirements:

1. Section 01 35 91 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 02 42 96 "Historic Removal and Dismantling" for historic removal and dismantling work.
3. Section 04 03 10 “Historic Masonry Cleaning” for cleaning and paint removal existing masonry.
4. Section 04 03 43 “Historic Stone Masonry Repointing” for repointing existing stonework.
5. Section 07 62 00 "Sheet Metal Flashing and Trim" for metal flashing installed in or on repaired stonework.
6. Section 07 92 00 “Joint Sealants” for joint sealants, joint fillers, and sealant-joint preparation for repaired masonry.

1.3 ALLOWANCES

A. Allowances for historic masonry repair are specified in Section 01 21 00 "Allowances."

1.4 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 01 22 00 "Unit Prices."

1. Unit prices apply to authorized work covered by quantity allowances.
2. Unit prices apply to additions to and deletions from Work as authorized by Change Orders.

1.5 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: 100 to 400 psi.
2. Flow Rate: 4 to 6 gpm.

B. Face Bedding: Setting of stone with the rift or natural bedding planes (strata) vertical and parallel to the wall plane rather than horizontal or "naturally bedded," which holds bedding planes together by gravity.

C. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

D. Rift: The most pronounced direction of splitting or cleavage of a stone.

E. Stone Terminology: ASTM C119.

1.6 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference on historic masonry repair and repointing at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to stone historic treatment and repair.
2. Review methods and procedures related to repairing historic stone masonry, including, but not limited to, the following:

a. Verify historic treatment specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
b. Materials, material application, sequencing, tolerances, and required clearances.
c. Quality-control program.
d. Fire-protection plan.
e. Stone historic treatment program.
f. Coordination with building occupants.

1.7 SEQUENCING AND SCHEDULING

A. Order sand and gray portland cement for colored mortar immediately after approval of mockups. Take delivery of and store at Project site a sufficient quantity to complete Project.

B. Work Sequence: Perform stone historic treatment work in the following sequence, which includes work specified in this and other Sections:

1. Remove plant growth.
2. Inspect stonework for open mortar joints and permanently or temporarily point them before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
3. Remove paint.
4. Clean stone.
5. Rake out mortar from joints surrounding stone to be replaced and from joints adjacent to stone repairs along joints.
6. Repair stonework, including replacing existing stone with new stone. If required, repair backup masonry.
7. Rake out mortar from joints to be repointed.
8. Point mortar and sealant joints.
9. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.
10. Where water repellents are to be used on or near stonework, delay application of these chemicals until after pointing and cleaning.

C. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in stone according to Part 3 "Stone Patching" Article. Patch holes in mortar joints according to Section 040343 "Historic Stone Masonry Repointing."

1.8 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include recommendations for product application and use.
3. Include test data substantiating that products comply with requirements.

B. Shop Drawings:

1. Include plans, elevations, sections, and locations of stone repair work on the structure.
2. Indicate complete dimensions for new stone units and their jointing, showing relation of existing to new units.
3. Show partial replacement stone units (dutchmen).

4. Indicate setting number of each new stone unit and its location on the structure in annotated plans and elevations.
5. Show provisions for expansion joints or other sealant joints.
6. Show provisions for flashing, lighting fixtures, conduits, and weep holes as required.
7. Show replacement and repair anchors, including drilled-in pins. Include details of anchors within individual stone units, with locations of anchors and dimensions of holes and recesses in stone required for anchors, including direction and angle of holes for pins.
8. Show locations of scaffolding and points of scaffolding in contact with masonry. Include details of each point of contact or anchorage.

C. Samples for Initial Selection: For the following:

1. Colored Mortar: Submit sets of mortar that will be left exposed in the form of sample mortar strips, 6 inches long by 1/4 inch wide, set in aluminum or plastic channels.

    a. Have each set contain a close color range of at least three Samples of different mixes of colored sands and cements that produce a mortar matching existing, cleaned mortar when cured and dry.
    b. Submit with precise measurements on ingredients, proportions, gradations, and sources of colored sands from which each Sample was made.

2. Each type of sand used for mortar; minimum 8 oz. of each in plastic screw-top jars.

    a. For blended sands, provide Samples of each component and blend. Identify blend ratio.
    b. Identify sources, both supplier and quarry, of each type of sand.

3. Patching Compound: Submit sets of patching compound Samples in the form of plugs (patches in drilled holes) in sample units of stone representative of the range of stone colors on the building.

    a. Have each set contain a close color range of at least three Samples of different mixes of patching compound that matches the variations in existing stone when cured and dry.

4. Sealant materials.
5. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For the following:

1. Each type of replacement stone. Include sets of Samples to show full range of color, texture, grain, veining, and finish to be expected. Provide sets of at least three 12-by-12-inch Samples for each type, but no fewer than necessary to indicate full range and the proportion of variations within range.
2. Each type of patching compound in form of briquettes, at least 3 inches long by 1-1/2 inches wide. Document each Sample with manufacturer and stock number or other information necessary to order additional material.
3. Each type of adhesive.
4. Each type, color, and texture of pointing mortar in the form of sample mortar strips, 6 inches long by 1/4 inch wide, set in aluminum or plastic channels.

    a. Include with each Sample a list of ingredients with proportions of each. Identify sources, both supplier and quarry, of each type of sand and brand names of cementitious materials and pigments if any.

5. Sealant materials.
6. Accessories: Each type of anchor, accessory, and miscellaneous support.

1.9 INFORMATIONAL SUBMITTALS

A. Qualification Data: For historic treatment specialist including field supervisors and workers and testing service.

B. Preconstruction Test Reports: For existing stone types and mortar and replacement stone types.

C. Quality-control program.

D. Stone historic treatment program.

1.10 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic stone repair and repointing specialist. Firm is to have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience installing standard unit masonry or new stone masonry and experience in pointing or repointing only new or nonhistoric masonry is insufficient experience for stone historic treatment work.

1. Field Supervision: Historic Treatment Specialist firms is to maintain experienced full-time supervisors on Project site during times that stone repair and repointing work is in progress.
2. Historic Treatment Worker Qualifications: When stone units are being patched, assign at least one worker per crew who is trained and certified by manufacturer of patching compound to apply its products.

B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising worker performance and preventing damage.

C. Stone Historic Treatment Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for each phase of the historic treatment work, including protection of surrounding materials and Project site.

1. Include methods for keeping exposed mortar damp during curing period.
2. If materials and methods other than those indicated are proposed for any phase of historic treatment work, add to the quality-control program a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project.

D. Mockups: Prepare mockups of historic treatment to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Stone Repair: Prepare sample areas for each type of stone indicated to have repair work performed. If not otherwise indicated, size each mockup not smaller than two adjacent whole units or approximately 48 inches in least dimension. Construct sample areas in locations in existing walls where directed by Architect unless otherwise indicated. Demonstrate quality of materials, workmanship, and blending with existing work. Include the following as a minimum:

a. Replacement: Four stone units replaced.
b. Partial Stone Replacement: Two partial stone replacements (dutchman repairs).
c. Stone Plug Repair: Two stone plug repairs for each type of stone indicated to be plugged.
d. Crack Injection: Apply crack injection in two separate areas, each approximately 36 inches long.
e. Patching: Three small holes at least 1 inch in diameter for each type of stone indicated to be patched, so as to leave no evidence of repair.

2. Repointing: Rake out joints in two separate areas, each approximately 36 inches high by 48 inches wide for each type of repointing required, and repoint one of the areas.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.11 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on stone masonry as follows:

1. Provide test specimens as indicated and representative of proposed materials and existing construction.
2. Replacement Stone: Test each proposed type of replacement stone, according to ASTM C170/C170M for compressive strength, wet and dry, perpendicular and parallel to rift; ASTM C99/C99M for modulus of rupture, wet and dry, perpendicular and parallel to rift; and ASTM C97/C97M for absorption and bulk specific gravity.
3. Existing Stone: Test each type of existing stone indicated for replacement, according to ASTM C170/C170M for compressive strength, wet and dry, perpendicular and parallel to rift; ASTM C99/C99M for modulus of rupture, wet and dry, perpendicular and parallel to rift; and ASTM C97/C97M for absorption and bulk specific gravity. Carefully remove five existing stones for testing from locations designated by Architect. Take testing samples from these stones.
4. Existing Mortar: Test according to ASTM C1324, modified as agreed by testing service and Architect for Project requirements, to determine proportional composition of original ingredients, sizes and colors of aggregates, and approximate strength. Use x-ray diffraction, infrared spectroscopy, and differential thermal analysis to supplement microscopical methods. Carefully remove existing mortar for testing from within joints at five locations designated by Architect or testing service.
5. Temporary Patch: As directed by Architect, provide temporary materials followed by permanent repairs at locations from which existing samples were taken.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Deliver stone to Project site strapped together in suitable packs or pallets or in heavy-duty crates and protected against impact and chipping.

B. Deliver each piece of stone with code mark or setting number on unexposed face, corresponding to Shop Drawings, using nonstaining paint.

C. Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

D. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

E. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.

F. Store lime putty covered with water in sealed containers.

G. Store sand where grading and other required characteristics can be maintained and contamination avoided.

H. Handle stone to prevent overstressing, chipping, defacement, and other damage.

1.13 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit repair work to be performed according to product manufacturers' written instructions and specified requirements.

B. Temperature Limits: Repair stonework only when air temperature is between 40 and 90 deg F and is predicted to remain so for at least seven days after completion of the Work unless otherwise indicated.

C. Cold-Weather Requirements: Comply with the following procedures for stone repair unless otherwise indicated:

1. When air temperature is below 40 deg F, heat mortar ingredients, repair materials, and existing stone to produce temperatures between 40 and 120 deg F.
2. When mean daily air temperature is below 40 deg F, provide enclosure and heat to maintain temperatures above 32 deg F within the enclosure for seven days after repair.

D. Hot-Weather Requirements: Protect stonework repairs when temperature and humidity conditions produce excessive evaporation of water from mortar and patching materials. Provide artificial shade and wind breaks, and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg F and above unless otherwise indicated.

E. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Source Limitations: Obtain each type of material for repairing historic masonry (stone, cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 MASONRY MATERIALS

A. Stone Matching Existing: Natural building stone of variety, color, texture, grain, veining, finish, size, and shape that match existing stone and with physical properties within 10 percent of those determined from preconstruction testing of selected existing stone.

1. For existing stone that exhibits a range of colors, textures, grains, veining, finishes, sizes, or shapes, provide stone that proportionally matches that range rather than stone that matches an individual color, texture, grain, veining, finish, size, or shape within that range.

B. Stone Matching Architect's Sample: Natural building stone of variety, color, texture, grain, veining, finish, and physical properties that match Architect's sample. Match existing stone in size and shape.

1. For Architect's sample that exhibits a range of colors, textures, grains, veining, finishes, sizes, or shapes, provide stone that proportionally matches that range rather than stone that matches an individual color, texture, grain, veining, finish, size, or shape within that range.

C. Quarrying New Stone: Have quarry clearly label the direction of rift or bedding planes when rough stone is quarried, to facilitate cutting stones so that natural bedding planes are as required in "Cutting New Stone" Paragraph.

D. Cutting New Stone: Regardless of how existing stone was cut and set, cut each new stone so that, when it is set in final position, the rift or natural bedding planes match the rift orientation of existing stones.

E. Salvaged Stone: Obtain from location indicated on Drawings. Clean off residual mortar.

F. Building Brick: Brick having same vertical dimension as existing backup brick, according to ASTM C62, Grade SW, MW, or NW, and Section 040322 "Historic Brick Unit Masonry Repair."

2.3 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II; white, gray, or both where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Factory-Prepared Lime Putty: ASTM C1489.

D. Quicklime: ASTM C5, pulverized lime.

E. Mortar Sand: ASTM C144 unless otherwise indicated.

1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Colored Mortar: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
3. For exposed mortar, provide sand with rounded edges.

F. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

G. Water: ASTM C270, potable.

2.4 MANUFACTURED REPAIR MATERIALS

A. Stone-Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching stone.

1. Use formulation that is vapor and water permeable (equal to or more than the stone), exhibits low shrinkage, has lower modulus of elasticity than the stone units being repaired, and develops high bond strength to all stone types.
2. Use formulation having working qualities and retardation control to permit forming and sculpturing where necessary.
3. Formulate patching compound in colors, textures, and grain to match stone being patched. Provide sufficient number of colors to enable matching each piece of stone.

B. Cementitious Crack Filler: Ultrafine superplasticized grout that can be injected into cracks, is suitable for application to wet or dry cracks, exhibits low shrinkage, and develops high bond strength to all stone types.

C. Stone-to-Stone Adhesive: Two-part polyester or epoxy-resin stone adhesive with a 15- to 45-minute cure at 70 deg F, recommended in writing by adhesive manufacturer for type of stone repair indicated, and matching stone color.

2.5 ACCESSORY MATERIALS

A. Stone Anchors and Pins: Type and size indicated or, if not indicated, to match existing anchors in size and type. Fabricate from Type 304 stainless steel.

B. Setting Buttons and Shims: Resilient plastic, nonstaining to stone, sized to suit joint thicknesses and bed depths of stone units, less the required depth of pointing materials unless removed before pointing.

C. Masking Tape: Nonstaining, nonabsorbent material; compatible with mortar, joint primers, sealants, and surfaces adjacent to joints; and that easily comes off entirely, including adhesive.

D. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer according to MPI #23 (surface-tolerant, anticorrosive metal primer or SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.

1. Surface Preparation: Use coating requiring no better than SSPC-SP 2, "Hand Tool Cleaning," surface preparation according to manufacturer's literature or certified statement.
2. VOC Limit: Use coating with a VOC content of 400 g/L or less.

E. Sealant Materials:

1. Sealant manufacturer's standard elastomeric sealant(s) of base polymer and characteristics

indicated below and according to applicable requirements in Section 079200 "Joint Sealants."

F. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing work involved.
2. Minimal possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could do the following:

a. Remove, alter, or harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in contract.
b. Leave residue on surfaces.

2.6 MORTAR MIXES

A. Preparing Lime Putty: Slake quicklime and prepare lime putty according to appendix in ASTM C5 and to manufacturer's written instructions.

B. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

C. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black, which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

D. Do not use admixtures in mortar unless otherwise indicated.

E. Mixes: Mix mortar materials in the following proportions:

1. Rebuilding (Setting) Mortar by Type: ASTM C270, Proportion Specification, Type O unless otherwise indicated; with cementitious material limited to portland cement and lime.
2. Rebuilding (Setting) Mortar by Property: ASTM C270, Property Specification, Type O unless otherwise indicated; with cementitious material limited to portland cement and lime.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT SPECIALIST

A. Historic Treatment Specialist Firms: Subject to compliance with requirements.

3.2 PROTECTION

A. Prevent mortar from staining face of surrounding stone and other surfaces.

1. Cover sills, ledges, and other projecting items to protect them from mortar droppings.
2. Keep wall area wet below rebuilding and repair work to discourage mortar from adhering.
3. Immediately remove mortar splatters in contact with exposed masonry and other surfaces.

B. Remove gutters and downspouts and associated hardware adjacent to immediate work area and store during stone repair work. Reinstall when repairs are complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.3 STONE REPAIR, GENERAL

A. Have repair work performed only by qualified historic treatment specialist.

B. Repair Appearance Standard: Repaired surfaces are to have a uniform appearance as viewed from 50 feet away by Architect.

3.4 ABANDONED ANCHOR REMOVAL

A. Remove abandoned anchors, brackets, wood nailers, and other extraneous items no longer in use unless indicated to remain.

1. Remove items carefully to avoid spalling or cracking stone.
2. Notify Architect before proceeding if an item cannot be removed without damaging surrounding stone; do the following where directed:

   a. Cut or grind off item approximately 3/4 inch beneath surface, and core drill a recess of same depth in surrounding stone as close around item as practical.
   b. Immediately paint exposed end of item with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended dry film thickness per coat. Keep paint off sides of recess.

3. Patch the hole where each item was removed unless directed to remove and replace the stone unit.

3.5 STONE REMOVAL AND REPLACEMENT

A. At locations indicated, remove stone that has deteriorated or is damaged beyond repair or is to be reused. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

B. Support and protect remaining masonry that was supported by removed stone.

C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition. Coordinate with new flashing, reinforcement, and lintels, which are specified in other Sections.

D. Notify Architect of unforeseen detrimental conditions, including voids, cracks, bulges, loose masonry units in existing stone or unit masonry backup, rotted wood, rusted metal, and other deteriorated items.

E. Remove in an undamaged condition as many whole stone units as possible.

1. Remove mortar, loose particles, and soil from stone by cleaning with hand chisels, brushes, and water.
2. Remove sealants by cutting close to stone with utility knife and cleaning with solvents.
3. Store stone for reuse. Store off ground, on skids, and protected from weather.
4. Deliver cleaned stone not required for reuse to Owner unless otherwise indicated.

F. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for stone replacement.

G. Replace removed damaged stone with other removed stone and salvaged stone in good condition, where possible, or with new stone matching existing stone. Do not use broken units unless they can be cut to usable size.

H. Rift: Do not allow face bedding of stone. Before setting, inspect to verify that each stone has been cut so that, when it is set in final position, the rift or natural bedding planes are predominantly horizontal , except for arches, where bedding planes are predominantly radial or vertical, but perpendicular to the wall. Reject stone with vertical bedding planes, except as required for arches, lintels, and copings.

I. Install replacement stone into bonding and coursing pattern of existing stone. If cutting is required, use a motor-driven saw designed to cut stone with clean, sharp, unchipped edges. Finish edges to blend with appearance of edges of existing stone.

1. Maintain joint width for replacement stone to match existing joints.
2. Use setting buttons or shims to set stone accurately spaced with uniform joints.

J. Set replacement stone with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter vertical joints for full width before setting, and set units in full bed of mortar unless otherwise indicated. Replace existing anchors with new anchors matching existing configuration unless otherwise indicated.

1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing stonework.
2. Rake out mortar used for laying stone before mortar sets according to Section 040343 "Historic Stone Masonry Repointing." Point at same time as repointing of surrounding area.
3. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.

K. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.6 BACKUP MASONRY REMOVAL AND REPLACEMENT

A. Where backup masonry is fractured or unstable and at locations indicated, remove mortar and masonry units that are broken or deteriorated, and rebuild with whole, new brick or whole, salvaged backup masonry units. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

B. Perform backup masonry removal and replacement according to requirements in Section 040322 "Historic Brick Unit Masonry Repair."

C. Support and protect remaining masonry that surrounds removal area.

D. Maintain flashing, reinforcement, anchors, lintels, and adjoining construction in an undamaged condition. Coordinate with new flashing, reinforcement, and lintels, which are specified in other Sections.

E. Notify Architect of unforeseen detrimental conditions, including voids, cracks, bulges, loose masonry units beyond the removal area, rotted wood, rusted metal, and other deteriorated items.

F. Remove in an undamaged condition as many whole bricks as possible.

1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
3. Store brick for reuse. Store off ground, on skids, and protected from weather.
4. Deliver cleaned brick not required for reuse to Owner unless otherwise indicated.

G. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.

H. Replace removed damaged brick with salvaged backup brick in good condition, where possible, or with new building brick matching existing backup brick. Do not use broken units unless they can be cut to usable size.

I. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

J. Lay replacement brick with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min.. Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.

K. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.7 PAINTING STEEL UNCOVERED DURING THE WORK

A. Notify Architect if steel is exposed during stone removal. Where Architect determines that it is structural, or for other reasons cannot be totally removed, prepare and paint steel as follows:

1. Surface Preparation: Remove paint, rust, and other contaminants according to SSPC-SP 2, "Hand Tool Cleaning, as applicable to comply with paint manufacturer's recommended preparation.
2. Antirust Coating: Immediately paint exposed steel with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended rate of application (dry film thickness per coat).

B. If on inspection and rust removal, the thickness of a steel member is found to be reduced from rust by more than 1/16 inch, notify Architect before proceeding.

3.8 PARTIAL STONE REPLACEMENT

A. Remove defective portion of existing stone unit (backing stone). Carefully remove defective portion of stone by making vertical and horizontal saw cuts at face of backing stone and removing defective material to depth required for fitting partial replacement (dutchman).

1. Make edges of backing stone at cuts smooth and square to each other and to finished surface; essentially rectangular. Make back of removal area flat and parallel to stone face.
2. Do not overcut at corners and intersections. Hand trim to produce clean sharp corners with no rounding and no damage to existing work to remain.
3. If backing stone becomes further damaged, remove damaged area and enlarge partial replacement as required.

B. Remove mortar from joints that abut area of stone removal to same depth as stone was removed. Remove loose mortar particles and other debris from surfaces to be bonded and surfaces of adjacent stone units that will receive mortar by cleaning with stiff-fiber brush.

C. Cut and trim partial replacement to accurately fit area where material was removed from backing stone. Fabricate to size required to produce joints between partial replacement and backing stone of no more than 1/16 inchin width, and to produce joints between partial replacement and other stones that match existing joints between stones. Cut partial replacement so that, when it is set in final position, natural bedding planes match the orientation of bedding planes of the backing stone unless otherwise indicated.

D. Pinning: Before applying adhesive, prepare for mechanical anchorage consisting of 1/4-inch- diameter, [plain][threaded] stainless-steel pins set into 1/4-inch- diameter holes drilled at a 45-degree downward angle through face of partial replacement and into backing stone.

1. Center and space pins between 3 and 5 inches apart and at least 2 inches from any edge. Insert pins at least 2 inches in backing stone and 2 inches in partial replacement, with end countersunk at least 3/4 inch from exposed face of partial replacement.

E. Concealed Pinning: Before applying adhesive, prepare for concealed mechanical anchorage consisting of 1/4-inch- diameter, [plain][threaded] stainless-steel pins set into 1/4-inch- diameter holes drilled into backing stone and into, but not through, the partial replacement.

1. Center and space pins between 3 and 5 inches apart and at least 2 inches from any edge. Insert pins at least 2 inches in backing stone and 2 inches in partial replacement, but no closer than 3/4 inch from exposed face of partial replacement.

F. Apply stone-to-stone adhesive according to adhesive manufacturer's written instructions. Coat bonding surfaces of backing stone and partial replacement, completely filling all crevices and voids.

G. Apply partial replacement while adhesive is still tacky, and hold securely in place until adhesive has cured. Use shims, clamps, wedges, or other devices as necessary to align face of partial replacement with face of backing stone.

H. Clean adhesive residue from exposed surfaces and patch chipped areas and exposed drill holes as specified in "Stone Patching" Article.

3.9 STONE PLUG REPAIR

A. Remove cylindrical piece of damaged stone by core-drilling perpendicular to stone surface.

B. Prepare a replacement plug by core-drilling replacement stone. Use a drill sized to produce a core that fits into hole drilled in damaged stone, with only minimum gap necessary for adhesive. Cut and install plug so that, when it is set in final position, natural bedding planes match the orientation of bedding planes of the backing stone unless otherwise indicated.

C. Apply stone-to-stone adhesive according to adhesive manufacturer's written instructions. Coat bonding surfaces of existing stone and plug, completely filling all crevices and voids.

D. Apply plug flush with surrounding stone while adhesive is still tacky, and hold securely in place until adhesive has cured.

E. Clean adhesive residue from exposed surfaces.

3.10 STONE-FRAGMENT REPAIR

A. Carefully remove cracked or fallen stone fragment indicated to be repaired. Reuse only stone fragment that is in sound condition.

B. Remove soil, loose particles, mortar, and other debris or foreign material from fragment surfaces to be bonded and from parent stone where fragment had broken off, by cleaning with stiff-fiber brush.

C. Pinning: Before applying adhesive, prepare for mechanical anchorage consisting of 1/4-inch- diameter, [plain][threaded] stainless-steel pins set into 1/4-inch- diameter holes drilled at a 45-degree downward angle through face of fragment and into parent stone.

1. Center and space pins 3 to 5 inches apart and at least 2 inches from any edge. Insert pins at least 2 inches in parent stone and 2 inches in fragment, with end countersunk at least 3/4 inch from exposed face of fragment.

D. Concealed Pinning: Before applying adhesive, prepare for concealed mechanical anchorage consisting of 1/4-inch- diameter, [plain][threaded] stainless-steel pins set into 1/4-inch- diameter holes drilled into parent stone and into, but not through, the fragment.

1. Center and space pins 3 to 5 inches apart and at least 2 inches from any edge. Insert pins at least 2 inches in parent stone and 2 inches in fragment, but no closer than 3/4 inch from exposed face of fragment.

E. Apply stone-to-stone adhesive according to adhesive manufacturer's written instructions. Coat bonding surfaces of fragment and parent stone, completely filling all crevices and voids.

F. Fit stone fragment onto parent stone while adhesive is still tacky, and hold fragment securely in place until

adhesive has cured. Use shims, clamps, wedges, or other devices as necessary to align face of fragment with face of parent stone.

G. Clean adhesive residue from exposed surfaces and patch chipped areas and exposed drill holes as specified in "Stone Patching" Article.

3.11 CRACK INJECTION

A. General: Comply with cementitious crack-filler manufacturer's written instructions.

B. Drill 1/4-inch- diameter injection holes as follows:

1. Transverse Cracks Less Than 3/8 inch Wide: Drill holes through center of crack at 12 to 18 inches o.c.
2. Transverse Cracks More Than 3/8 inch Wide: Drill holes through center of crack at 18 to 36 inches o.c.
3. Delaminations: Drill holes at approximately 18 inches o.c., both vertically and horizontally.
4. Drill holes 2 inches deep.

C. Clean out drill holes and cracks with compressed air and water. Remove dirt and organic matter, loose material, sealants, and failed crack repair materials.

D. Place plastic injection ports in drilled holes, and seal face of cracks between injection ports with clay or other nonstaining, removable plugging material. Leave openings at upper ends of cracks for air release.

E. Inject cementitious crack filler through ports sequentially, beginning at one end of area and working to opposite end; where possible, begin at lower end of injection area and work upward. Inject filler until it extrudes from adjacent ports. After port has been injected, plug with clay or other suitable material, and begin injecting filler at adjacent port, repeating process until all ports have been injected.

F. Clean cementitious crack filler from face of stone before it sets, by scrubbing with water.

G. After cementitious crack filler has set, remove injection ports, plugging material, and excess filler. Patch injection holes and surface of cracks as specified in "Stone Patching" Article.

3.12 STONE PATCHING

A. Patch the following stone units unless another type of repair or replacement is indicated:

1. Units indicated to be patched.
2. Units with holes.
3. Units with chipped edges or corners. Patch chipped edges or corners measuring more than 3/4 inch in least dimension.
4. Units with small areas of deep deterioration. Patch deep deteriorations measuring more than 3/4 inch in least dimension and over 1/4 inch deep.

B. Remove and replace existing patches where indicated.

C. Remove deteriorated material, and remove adjacent material that has begun to deteriorate. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least 1/4 inch thick, but not less than as recommended in writing by patching compound manufacturer.

D. Mask adjacent mortar joint or rake out for repointing if patch extends to edge of stone unit.

E. Mix patching compound in individual batches to match each stone unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.

F. Brush-coat stone surfaces with slurry coat of patching compound according to manufacturer's written

instructions.

G. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch or more than 2 inches thick. Roughen surface of each layer to provide a key for next layer.

1. Simple Details: Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of the stone. Shape and finish surface before or after curing, as determined by testing, to best match existing stone.
2. Carved Details: Build patch up 1/4 inch above surrounding stone, and carve surface to match adjoining stone after patching compound has hardened.

H. Keep each layer damp for 72 hours or until patching compound has set.

I. Remove and replace patches with hairline cracks or that show separation from stone at edges, and those that do not match adjoining stone in color or texture.

3.13 STONE REPOINTING, GENERAL

A. Have repointing work performed only by qualified historic treatment specialist.

B. Appearance Standard: Repointed surfaces are to have a uniform appearance as viewed from 50 feet away by Architect.

3.14 REPOINTING

A. Rake out and repoint joints to the following extent:

1. All joints in areas indicated.
2. Joints indicated as sealant-filled joints.
3. Joints at locations of the following defects:

a. Holes and missing mortar.
b. Cracks that can be penetrated 1/4 inch or more by a knife blade 0.027 inch thick.
c. Cracks 1/8 inch or more in width and of any depth.
d. Hollow-sounding joints when tapped by metal object.
e. Eroded surfaces 1/4 inch or more deep.
f. Deterioration to point that mortar can be easily removed by hand, without tools.
g. Joints filled with substances other than mortar.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of 2 times the joint width and not less than that required to expose sound, unweathered mortar . Do not remove unsound mortar more than 2 inches deep; consult Architect for direction.
2. Remove mortar from stone surfaces within raked-out joints to provide reveals with square backs and to expose stone for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of stone units or widen joints. Replace or patch damaged stone units as directed by Architect.

a. Cut out mortar by hand with chisel and resilient mallet. Do not use power-operated grinders without Architect's written approval based on approved quality-control program.
b. Cut out center of mortar bed joints using angle grinders with diamond-impregnated metal blades. Remove remaining mortar in bed joints and mortar in head joints by hand with chisel and resilient mallet. Strictly adhere to approved quality-control program.

D. Notify Architect of unforeseen detrimental conditions, including voids in mortar joints, cracks, loose stone,

rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch until a uniform depth is formed. Fully compact each layer thoroughly, and allow it to become thumbprint hard before applying next layer.
3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 3/8 inch. Fully compact each layer, and allow it to become thumbprint hard before applying next layer. Where existing stone has worn or rounded edges, slightly recess finished mortar surface below face of stone to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed stone surfaces or to featheredge the mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

    a. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.
    b. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.

6. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Remove mortar and repoint.

F. Pointing with Sealant: Comply with Section 079200 "Joint Sealants" and as follows:

1. After raking out, keep joints dry and free of mortar and debris.
2. Clean and prepare joint surfaces. Prime joint surfaces unless sealant manufacturer recommends against priming. Do not allow primer to spill or migrate onto adjoining surfaces.
3. Fill sealant joints with specified joint sealant.

    a. Install cylindrical sealant backing beneath the sealant. Where space is insufficient for cylindrical sealant backing, install bond-breaker tape.
    b. Install sealant using only proven installation techniques that ensure that sealant is deposited in a uniform, continuous ribbon, without gaps or air pockets, and with complete wetting of the joint bond surfaces equally on both sides. Fill joint flush with surrounding stonework and matching the contour of adjoining mortar joints.
    c. Install sealant as recommended in writing by sealant manufacturer but within the following general limitations, measured at the center (thin) section of the bead:

        1) Fill joints to a depth equal to joint width, but not more than 1/2 inch deep or less than 1/4 inch deep.

    d. Tool sealant to form smooth, uniform beads, slightly concave. Remove excess sealant from surfaces adjacent to joint.
    e. Sanded Joints: Immediately after first tooling, apply ground-mortar aggregate to sealant, gently pushing aggregate into the surface of sealant. Lightly retool sealant to form smooth, uniform beads, slightly concave. Remove excess sealant and aggregate from surfaces adjacent to joint.
    f. Do not allow sealant to overflow or spill onto adjoining surfaces, or to migrate into the voids of adjoining surfaces, particularly rough textures. Remove excess and spillage of sealant promptly as the work progresses. Clean adjoining surfaces by the means necessary to eliminate evidence of spillage, without damage to adjoining surfaces or finishes, as demonstrated in an approved mockup.

G. Where repointing work precedes cleaning of existing stone, allow mortar to harden at least 30 days before beginning cleaning work.

3.15 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed stone surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

B. Clean adjacent nonstone surfaces. Use detergent and soft brushes or cloths.

C. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.

D. Remove masking materials, leaving no residues that could trap dirt.

E. Sweep and rake adjacent pavement and grounds to remove mortar and debris. Where necessary, pressure-wash pavement surfaces to remove mortar, dust, dirt, and stains.

3.16 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage qualified testing agencies to perform tests and inspections. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.

B. Architect's Project Representatives: Architect will assign Project representatives to help carry out Architect's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Architect's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.

C. Notify inspector and Architect's Project representatives in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until inspectors and Architect's Project representatives have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.

3.17 STONE-WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess stone materials are Contractor's property.

B. Stone Waste: Remove stone waste and legally dispose of off Owner's property.

END OF SECTION 04 03 42

SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry-joint reinforcement.
5. Ties and anchors.
6. Embedded flashing.
7. Miscellaneous masonry accessories.
8. Cavity-wall insulation.

B. Products installed but not Furnished under This Section:

1. Cast-stone trim in unit masonry.

C. Related Requirements:

1. Section 03 30 00 “Cast-in-Place Concrete” for installing dovetail slots for masonry anchors.
2. Section 04 03 20 “Historic Brick Unit Masonry Repair and Repointing” for repair and repointing of brick unit masonry.
3. Section 04 03 42 “Historic Stone Masonry Repair and Repointing” for repair and repointing of stone.
4. Section 04 72 00 “Cast Stone Masonry” for furnishing cast stone trim.
5. Section 05 12 00 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
6. Section 05 50 00 “Metal Fabrications” for furnishing steel lintels and steel shelf angles for unit masonry.
7. Section 07 62 00 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

C. Architectural Stone Veneer: An architectural stone unit manufacturer to copy fine grain texture and color of natural cut stone. Meets ASTM C90 requirements.

D. Dry Cast Concrete Products: Manufacturer from zero-slump concrete.

E. Machine Casting Method: Vibratory compaction by machine of earth-moist, zero-slump concrete against rigid mold until it is densely compacted.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Verification: For each type and color of the following:

1. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.
2. Weep holes and cavity vents.
3. Accessories embedded in masonry.

1.6 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Qualification Data: For testing agency.

C. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include material test reports substantiating compliance with requirements.
b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Integral water repellent used in CMUs.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Reinforcing bars.
8. Joint reinforcement.
9. Anchors, ties, and metal accessories.

D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C1093 for testing indicated.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups for typical exterior wall in sizes approximately 48 inches(1200 mm) long by 48 inches(1200 mm) high by full thickness, including face and backup wythes and accessories.

a. Include a sealant-filled joint at least 16 inches (400 mm) long in exterior wall mockup.
b. Include through-wall flashing installed for a 24-inch (600-mm) length in corner of exterior wall mockup approximately 16 inches (400 mm) down from top of mockup, with a 12-inch (300-mm) length of flashing left exposed to view (omit masonry above half of flashing).
c. Include studs, sheathing, sheathing joint-and-penetration treatment air barrier, veneer anchors, flashing, cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.
d. Provide full-size cast stone units for use in construction of wall mockup.

2. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
3. Clean exposed faces of mockups with masonry cleaner as indicated.
4. Protect accepted mockups from the elements with weather-resistant membrane.
5. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.

a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls, and hold cover securely in place.

2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe, and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.
2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C1314.

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.4 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide bullnose units for outside corners unless otherwise indicated.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E514/E514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) ACM Chemistries.
2) Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
3) GCP Applied Technologies Inc.

C. CMUs: ASTM C90, Type I, Moisture Controlled.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi(19.3 MPa) .
2. Density Classification: Normal weight or light weight CMU units are permissible. Lightweight CMU shall be used at exposed painted walls, while normal weight can be used elsewhere.
3. Size (Width): Manufactured to dimensions 3/8 inch (10 mm) less than nominal dimensions.
4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

2.5 CONCRETE AND MASONRY LINTELS

A. Concrete Lintels: ASTM C1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than that of CMUs.

2.6 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Colored Cement Products: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Colored Portland Cement-Lime Mix: to match Lehigh Custom Color, or equal, as selected from manufacturer's full range.

2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
3. Pigments shall not exceed 10 percent of portland cement by weight.

E. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

F. Aggregate for Grout: ASTM C404.

G. Colored Cement Product: Packaged blend made from Portland cement and hydrated lime.

1. Colored Portland Cement-Lime Mix.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Capital Materials Corporation; Riverton Portland Cement Lime Custom Color.
2) Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
3) Lafarge North America Inc.; Eaglebond Portland & Lime.
4) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.

2. Formulate blend as required to produce colors indicated.

a. Match existing mortar whenever working at infills on the existing building.
b. Architect to select additional mortar colors for use in new construction in the range of Cast Stone specified.

1) As selected by Architect from manufacturer’s full range of colors.

3. Pigments shall not exceed 10 percent of portland cement by weight.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
b. GCP Applied Technologies Inc.
c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.

I. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ACM Chemistries.
b. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
c. GCP Applied Technologies Inc.

J. Water: Potable.

2.7 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60 (Grade 420).

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: ASTM A951/A951M.

1. Interior Walls: Hot-dip galvanized carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 0.157-inch(4.00-mm) diameter.
4. Wire Size for Cross Rods: 0.157-inch(4.00-mm) diameter.
5. Wire Size for Veneer Ties: 0.157-inch(4.00-mm) diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
7. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.

D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.

E. Masonry-Joint Reinforcement for Multiwythe Masonry:

1. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum horizontal play of 1/16 inch (1.5 mm) and maximum vertical adjustment of 1-1/4 inches (32 mm). Size ties to extend at least halfway through facing wythe but with at least 5/8-inch (16-mm) cover on outside face. Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.

2.8 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches (38 mm) into veneer but with at least a 5/8-inch (16-mm) cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A641/A641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
3. Stainless Steel Wire: ASTM A580/A580M, Type 304 .
4. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304 .
5. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
6. Stainless Steel Bars: ASTM A276 or ASTM A666, Type 304.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches (100 mm) wide.

1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches (50 mm) long may be used for masonry constructed from solid units.
2. Where wythes do not align are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches (32 mm) .
3. Wire: Fabricate from 3/16-inch-(4.76-mm-) diameter, hot-dip galvanized steel wire.

D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.35-mm-) diameter, hot-dip galvanized steel wire.
2. Tie Section: Triangular-shaped wire tie made from 0.187-inch-(4.76-mm-) diameter, hot-dip galvanized steel wire.

E. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch-(1.52-mm-) thick steel sheet, galvanized after fabrication .
2. Tie Section: Triangular-shaped wire tie made from 0.187-inch-(4.76-mm-) diameter, hot-dip galvanized steel wire.

F. Partition Top Anchors: 0.105-inch- (2.66-mm-) thick metal channel with two 7/16-inch- (11.11-mm-) diameter holes. 8-inches long x 2'inches high x block width. Fabricate from steel, hot-dip galvanized after fabrication. PTA 422 by Hohmann & Barnard, inc., or equivalent.

G. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf (445-N) load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch (1.5 mm).
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.075-inch-(1.90-mm-) thick steel sheet, galvanized after fabrication.
3. Fabricate wire ties from 0.187-inch-(4.76-mm-) diameter, hot-dip galvanized-steel wire unless otherwise indicated.
4. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a gasketed sheet metal anchor section, 1-1/4 inches (32 mm) wide by 6 inches (152 mm) long, with screw holes top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation or sheathing; and raised rib-stiffened strap, 5/8 inch (16 mm) wide by 6 inches (152 mm) long, stamped into center to provide a slot between strap and base for inserting wire tie. Self-adhering, modified bituminous gasket fits behind anchor plate and extends beyond pronged legs.
5. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a corrosion-resistant, self-drilling, eye-screw designed to receive wire tie. Eye-screw has spacer that seats directly against framing and is same thickness as sheathing and has gasketed washer head that covers hole in sheathing.
6. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 (4.83-mm) diameter by length required to penetrate steel stud flange with not less than three exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours according to ASTM B117.
7. Stainless Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 (4.83-mm) diameter by length required to penetrate steel stud flange with not less than three exposed threads; either made from Type 410 stainless steel or made with a carbon-steel drill point and 300 Series stainless steel shank.

2.9 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch (0.40 mm) thick.
2. Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through-wall metal flashing embedded in masonry from stainless steel copper, with ribs at 3-inch (76-mm) intervals along length of flashing to provide an integral mortar bond.
4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
5. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
6. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch (19 mm) at exterior face of wall and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
7. Fabricate metal drip edges and sealant stops for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches (76 mm) into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam sheds water.

8. Fabricate metal drip edges from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
9. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches (76 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
10. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.
11. Solder metal items at corners.

B. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Copper-Laminated Flashing: 7-oz./sq. ft.(2-kg/sq. m) copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Advanced Building Products Inc.; Copper Sealtite 2000.
2) Hohmann & Barnard, Inc; Copper Fabric Flashing NA.
3) Wire-Bond; Copper Seal Flashing #4140.
4) York Manufacturing, Inc; Multi-Flash 500.

2. Stainless Steel Flashing: Stainless Steel core flexible flashing with drainage fabric. Use only where flashing is fully concealed in masonry. Stainless steel drip-edge not required if stainless steel flashing is installed to face of veneer.

a. Products: Subject to compliance with requirements, provide one of the following:

1) York Flash Vent Stainless Steel or approved equal.

C. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge.
4. Where flashing is fully concealed, use metal flashing or flexible flashing.

D. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from UV-resistant, high-density polyethylene. Cell flashing pans have integral weep spouts designed to be built into mortar bed joints and that extend into the cell to prevent clogging with mortar.

E. Solder and Sealants for Sheet Metal Flashings: As specified in Section 07 62 00 "Sheet Metal Flashing and Trim."

F. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene .

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

D. Weep/Cavity Vent Products: Use the following unless otherwise indicated:

1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe, in color selected from manufacturer's standard.

    a. Products: Subject to compliance with requirements, provide one of the following:

        1) Advanced Building Products Inc.; Mortar Maze Weep Vent.
        2) Hohmann & Barnard, Inc; QV Quadro-Vent.
        3) Wire-Bond; Cell Vent (#3601).

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Advanced Building Products Inc.; Mortar Break II.
    b. Hohmann & Barnard, Inc; Mortar Trap.
    c. Mortar Net Solutions; Mortar Net with Insect Barrier.
    d. Wire-Bond; Cavity Net DT.
    e. York Manufacturing, Inc; Weep-Net™.

2. Configuration: Provide one of the following:

    a. Strips, full depth of cavity and 10 inches (250 mm) high, with dovetail-shaped notches 7 inches (175 mm) deep that prevent clogging with mortar droppings.

2.11 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Diedrich Technologies, Inc.
    b. EaCo Chem, Inc.
    c. ProSoCo, Inc.

2.12 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime mortar.
4. For reinforced masonry, use portland cement-lime mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type M.

2. For reinforced masonry, use Type S.
3. For mortar parge coats, use Type N.
4. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
5. For interior nonload-bearing partitions, Type O may be used instead of Type N.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Mix to match Architect's sample.
3. Application: Use pigmented mortar for exposed mortar joints with the following units:

a. Cast-stone trim units.

E. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C143/C143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm) .
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm) .
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m) , or 1/2-inch (12-mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m) , 1/4 inch in 20 feet (6 mm in 6 m) , or 1/2-inch (12-mm) maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m) , 3/8 inch in 20 feet (9 mm in 6 m) , or 1/2-inch (12-mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m) , 1/4 inch in 20 feet (6 mm in 6 m) , or 1/2-inch (12-mm) maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m) , 3/8 inch in 20 feet (9 mm in 6 m) , or 1/2-inch (12-mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet ((6 mm in 3 m),) or 1/2-inch (12-mm) maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm) , with a maximum thickness limited to 1/2 inch (12 mm) .
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm) .
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm) .
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm) . Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch(3 mm) .
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond ; do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches(100 mm) . Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Fasten partition top anchors to structure above per manufacturer's recommendation and build partition into anchor. Space anchors 48 inches(1200 mm) o.c. unless otherwise indicated.
3. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 07 84 43 "Joint Firestopping."

J. Refer to Manufacturer's specific instructions in laying architectural stone veneer and cast stone trim.

3.5 MORTAR BEDDING AND JOINTING

A. Lay CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Allow cleaned surfaces to dry before setting.
3. Wet joint surfaces thoroughly before applying mortar.
4. Rake out mortar joints for pointing with sealant.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

1. For glazed masonry units, use a nonmetallic jointer 3/4 inch (19 mm) or more in width.

E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

F. Cut joints flush where indicated to receive waterproofing cavity wall insulation air barriers unless otherwise indicated.

3.6 SETTING CAST STONE MASONRY IN MORTAR

A. Set cast stone as indicated on Drawings. Set units accurately in locations indicated, with edges and faces aligned according to established relationships and indicated tolerances.

1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
2. Coordinate installation of cast stone with installation of flashing specified in other Sections.

B. Wet joint surfaces thoroughly before applying mortar or setting in mortar.

C. Set units in full bed of mortar with full head joints unless otherwise indicated.

1. Set units with joints 3/8 inch (10 mm) wide unless otherwise indicated.
2. Build anchors and ties into mortar joints as units are set.
3. Fill dowel holes and anchor slots with mortar.
4. Fill collar joints solid as units are set.
5. Build concealed flashing into mortar joints as units are set.
6. Keep head joints in copings and between other units with exposed horizontal surfaces open to receive sealant.
7. Keep joints at shelf angles open to receive sealant.

D. Rake out joints for pointing with mortar to depths of not less than 3/4 inch (19 mm). Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.

E. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch (10 mm). Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.

F. Tool exposed joints slightly concave when thumbprint hard. Use a smooth plastic jointer larger than joint thickness.

G. Rake out joints for pointing with sealant to depths of not less than 3/4 inch (19 mm). Scrub faces of units to remove excess mortar as joints are raked.

H. Provide sealant joints at expansion, control, and pressure-relieving joints; and at locations indicated.

1. Keep joints free of mortar and other rigid materials.
2. Build in compressible foam-plastic joint fillers where indicated.
3. Form joint of width indicated, but not less than 3/8 inch (10 mm).
4. Prime cast-stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
5. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 07 92 00 "Joint Sealants."

3.7 ADJUSTING AND CLEANING CAST STONE MASONRY

A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.

B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.

C. In-Progress Cleaning: Clean cast stone as work progresses.

1. Remove mortar fins and smears before tooling joints.
2. Remove excess sealant immediately, including spills, smears, and spatter.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
5. Clean cast stone by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

3.8 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods :

1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 1.77 sq. ft.(0.16 sq. m) of wall area spaced not to exceed 16 inches(406 mm) o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (915 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.

    a. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) ties.
    b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) ties to allow for differential movement regardless of whether bed joints align.

2. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.

    a. Where bed joints of both wythes align, use tab-type reinforcement.
    b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement.
    c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) reinforcement to allow for differential movement regardless of whether bed joints align.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

C. Coat cavity face of backup wythe to comply with Section 07 14 16 "Cold Fluid-Applied Waterproofing."

D. Apply air barrier to face of backup wythe to comply with Section 07 27 26 "Fluid-Applied Membrane Air Barriers."

E. Installing Cavity Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches (300 mm) o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.9 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to wall framing and concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.

2. Embed tie sections in masonry joints.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 18 inches (458 mm) o.c. vertically and horizontally. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 24 inches (610 mm), around perimeter.

B. Provide not less than 2 inches (50 mm) of airspace between back of masonry veneer and face of sheathing or insulation.

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.10 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm) .

1. Space reinforcement not more than 16 inches (406 mm) o.c.
2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.11 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:

1. Provide an open space not less than 1/2 inch(13 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.12 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

C. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 92 00 "Joint Sealants," but not less than 3/8 inch(10 mm).

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.13 LINTELS

A. Install steel lintels where indicated.

B. Provide concrete lintels where shown and where openings of more than 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.14 FLASHING, WEEP HOLES, AND CAVITY VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches(200 mm), and through inner wythe to within 1/2 inch (13 mm) of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches (50 mm) on interior face.
3. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches (200 mm); with upper edge tucked under air barrier, lapping at least 4 inches (100 mm) .
4. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
5. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
6. Install metal drip edges with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
7. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
8. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
9. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

E. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/cavity vent products to form weep holes.
2. Use wicking material to form weep holes above flashing under sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
3. Space weep holes 24 inches (600 mm) o.c. unless otherwise indicated.

F. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches (50 mm), to maintain drainage.

1. Fill cavities full height by placing pea gravel in cavities as masonry is laid, so that at any point, masonry does not extend more than 24 inches (600 mm) above top of pea gravel.

G. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

H. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form cavity vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.15 REINFORCED UNIT MASONRY

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches(1520 mm).

3.16 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for mortar air content and compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

I. Prism Test: For each type of construction provided, according to ASTM C1314 at 7 days and at 28 days.

3.17 PARGING

A. Parge exterior faces of below-grade masonry walls, where indicated, in 2 uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat and scarify first coat to ensure full bond to subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.18 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
7. Clean stone trim to comply with stone supplier's written instructions.
8. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

3.19 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

1. Owner shall be given first right of refusal on all excess materials at end of project.

B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 20 00

SECTION 04 72 00 - CAST STONE MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wall panels
2. Trim units.
3. Decorative elements.
4. Mortar materials.
5. Accessories.

B. Related Requirements:

1. Section 04 20 00 "Unit Masonry" for installing cast-stone units in unit masonry.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For cast stone units, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.

1. Include building elevations showing layout of units and locations of joints and anchors.

C. Samples for Initial Selection: For colored mortar.

D. Samples for Verification:

1. For each color and texture of cast stone required, 10 inches square in size.
2. For each trim shape required, 4 inches in length.
3. For colored mortar, make Samples using same sand and mortar ingredients to be used on Project. Label Samples to indicate types and amounts of pigments used.

E. Full-Size Samples: For each color, texture and shape of cast-stone unit required.

1. Make available for Architect's review at Project site.
2. Make Samples from materials to be used for units used on Project immediately before beginning production of units for Project.
3. Approved Samples may be installed in the Work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and testing agency.

1. Include copies of material test reports, indicating compliance of cast stone with ASTM C1364.

B. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C1364.

1. Provide test reports based on testing within previous six months.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer of cast-stone units similar to those indicated for this Project that has sufficient production capacity to manufacture required units, and is a plant certified by the Cast Stone Institute, the Architectural Precast Association, or the Precast/Prestressed Concrete Institute for Group A, Category AT.

B. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

C. Source Limitations for Cast Stone: Obtain cast stone units through single source from single manufacturer.

D. Mockups: Furnish cast stone for installation in mockups specified in Section 04 20 00 "Unit Masonry."

E. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of typical wall area as shown on Drawings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Coordinate delivery of cast stone with unit masonry work to avoid delaying the Work and to minimize the need for on-site storage.

B. Pack, handle, and ship cast stone units in suitable packs or pallets.

1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units if required, using dollies with wood supports.
2. Store cast stone units on wood skids or pallets with nonstaining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

D. Store mortar aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

1.7 PROJECT CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements in TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until cast stone has dried, but no fewer than seven days after completing cleaning.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements in TMS 602.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Cast Stone: Obtain cast stone units from single source from single manufacturer.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

2.2 CAST STONE MATERIALS

A. General: Comply with ASTM C1364.

B. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.

C. Embedded Anchors and Other Inserts: Fabricated from stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666, Type 304.

2.3 CAST STONE UNITS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Continental Cast Stone, East.
2. Hoyle Stone Products.
3. Sun Precast Co., Inc.
4. Reading Rock, Inc.

B. Cast Stone Units: Comply with ASTM C1364.

1. Units shall be manufactured using the vibrant dry tamp or wet-cast method.
2. Wall Panels: Sizes as indicated on Drawings.

a. Engravings: As indicated on Drawings.

3. Trim units including window sills lintels surrounds mullions copings cornices wall caps belt courses water tables quoins keystones items as indicated on Drawings.
4. Provide units that are resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666/C 666M, Procedure A, as modified by ASTM C 1364.

C. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.

1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
3. Provide drips on projecting elements unless otherwise indicated.

D. Fabrication Tolerances:

1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch.
2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than 1/4 inch.
3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.
4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch on formed surfaces of units and 3/8 inch on unformed surfaces.

E. Cure Units as Follows:

1. Cure units in enclosed, moist curing room at 95 percent relative humidity and temperature of 100 deg F (38 deg C) for 12 hours or 70 deg F (21 deg C) for 16 hours.
2. Keep units damp and continue curing to comply with one of the following:

a. No fewer than five days at mean daily temperature of 70 deg F or above.
b. No fewer than seven days at mean daily temperature of 50 deg F or above.

F. Acid etch units after curing to remove cement film from surfaces to be exposed to view.

G. Colors and Textures: As selected by Architect from manufacturer's full range .

2.4 MORTAR MATERIALS

A. Provide mortar materials that comply with Section 04 20 00 "Unit Masonry."

2.5 ACCESSORIES

A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666 .

B. Dowels: 1/2-inch diameter round bars, fabricated from Type 304 stainless steel complying with ASTM A240/A240M, ASTM A276/A276M, or ASTM A666 .

2.6 MORTAR MIXES

A. Comply with requirements in Section 04 20 00 "Unit Masonry" for mortar mixes.

2.7 SOURCE QUALITY CONTROL

A. Engage a qualified independent testing agency to sample and test cast stone units according to ASTM C1364.

1. Include one test for resistance to freezing and thawing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SETTING CAST STONE IN MORTAR

A. Install cast stone units to comply with requirements in Section 04 20 00 "Unit Masonry."

B. Wet joint surfaces thoroughly before applying mortar or setting in mortar.

C. Set units in full bed of mortar with full head joints unless otherwise indicated.

3.3 ADJUSTING AND CLEANING

A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.

B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.

END OF SECTION 04 72 00

SECTION 04 73 00 – MANUFACTURED MASONRY VENEER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Portland cement based manufactured stone veneer and trim.

B. Related Requirements:

1. Section 03 30 00 “Cast-in-Place Concrete” for installing dovetail slots for masonry anchors.
2. Section 04 03 20 “Historic Brick Unit Masonry Repair and Repointing” for repair and repointing of brick unit masonry.
3. Section 04 03 42 “Historic Stone Masonry Repair and Repointing” for repair and repointing of stone.
4. Section 04 20 00 “Unit Masonry” for furnishing and installing of masonry.
5. Section 05 12 00 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
6. Section 05 50 00 “Metal Fabrications” for furnishing steel lintels and steel shelf angles for masonry veneer.
7. Section 07 62 00 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.3 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI A118.4 Specifications for Latex-Portland Cement Mortar.
2. ANSI A118.15 – American National Standard Specification for Improved Modified Dry-Set Cement Mortar

B. American Society for Testing and Materials (ASTM):

1. ASTM C140/C140M – Standard Test Method for Sampling and Testing Concrete Masonry Units and Related Units
2. ASTM C270 – Standard Specification for Mortar for Unit Masonry.
3. ASTM C847 – Standard Specification for Metal Lath
4. ASTM C933 – Standard Specification for Welded Wire Lath
5. ASTM C1670/C1670M – Standard Specification for Adhered Manufactured Stone Masonry Veneer Units
6. ASTM C1714/C1714M – Standard Specification for Preblended Dry Mortar Mix for Unit Masonry
7. ASTM C1780 – Standard Practice for Installation Methods for Cement-Based Adhered Masonry Veneer
8. ASTM D226/D226M – Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
9. ASTM E2556/E2556M – Standard Specification for vapor Permeable Flexible Sheet Water-Resistive Barriers Intended for Mechanical Attachment
10. ICC AC38 Acceptance Criteria for Water Resistive Barriers

C. International Code Council (ICC):

1. ESR Report.

D. Underwriter’s Laboratory (UL): Building Materials Directory.

1.4 SUBMITTALS

A. Reference Section 01 33 00 – Submittal Procedures; submit following items:

1. Product Data.
2. Samples:

a. Standard sample board consisting of small-scale pieces of veneer units showing full range of textures and colors.
b. Full range of mortar colors.

3. Verification Samples: Following initial sample selection submit “laid-up” sample board using the selected stone and mortar materials and showing the full range of colors expected in the finished Work; minimum sample size: 3 by 3 feet (1 by 1 m).
4. Quality Assurance/Control Submittals:

a. Qualifications:

1) Proof of manufacturer qualifications.
2) Proof of installer qualifications.

b. Regulatory Requirements: Evaluation reports.
c. Veneer manufacturer’s installation instructions.
d. Installation instructions for other materials.

B. Closeout Submittals: Reference Section 01 78 00 Closeout Submittals; submit following items:

1. Maintenance Instructions.
2. Special Warranties.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer Qualifications
2. Installer Qualifications: Experienced mason familiar with installation procedures and related local, state and federal codes masonry.

B. Certifications:

1. ICC Evaluation Service – Evaluation Report ESR-1215.
2. ASTM C1670

1.6 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups of typical exterior wall area not less than 48 inches long by 48 inches high.

a. Include typical components, attachments to building structure, and methods of installation.
b. Include window opening with stone trim.
c. Include sealant-filled joint complying with requirements in Section 079200 "Joint Sealants."
d. Include an area that has been damaged and repaired.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Chane Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.

1. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
2. Store stone on wood skids or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.

B. Mark stone units, on surface that will be concealed after installation, with designations used on Shop Drawings to identify individual stone units. Orient markings on vertical panels so that they are right side up when units are installed.

C. Deliver sealants to Project site in original unopened containers labeled with manufacturer's name, product name and designation, color, expiration period, pot life, curing time, and mixing instructions for multicomponent materials.

D. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

1.8 FIELD CONDITIONS

A. Protect stone cladding during erection by doing the following:

1. Cover tops of stone installation with nonstaining, waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress. Extend cover a minimum of 24 inches down both sides and hold securely in place.
2. Prevent staining of stone from mortar, grout, sealants, and other sources. Immediately remove such materials without damaging stone.
3. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on ground and over wall surface.
4. Protect sills, ledges, and projections from mortar and sealant droppings.

B. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Remove and replace stone cladding damaged by frost or freezing conditions. Comply with cold-weather construction and protection requirements for masonry contained in TMS 602/ACI 530.1/ASCE 6.

C. Hot-Weather Requirements: Comply with hot-weather construction and protection requirements for masonry contained in TMS 602/ACI 530.1/ASCE 6.

D. Environmental Limitations for Sealants: Do not install sealants when ambient and substrate temperatures are outside limits permitted by sealant manufacturer or below 40 deg F or when joint substrates are wet.

1.9 WARRANTY

A. Special Warranty: Manufacturer’s standard warranty coverage against defects in materials when installed in accordance with manufacturer’s installation instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following, or an approved equal:

1. Eldorado Stone, a Westlake Royal Building Products company
2. Shouldice Stone
3. Rockcast, a Reading Rock company

B. Product: Ashlar, 2-piece setting pattern

C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 – Product Requirements.

2.2 MATERIALS

A. Stone Veneer:

1. Profile: chiseled, tumbled.
2. Color: match existing adjacent stone.

B. Accessories:

1. Stone Accessories: chiseled stone sill.
2. Color: match veneer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates upon which work will be installed.

B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.

C. Commencement of work by installer is acceptance of substrate.

3.2 PREPARATION

A. Protection: Protect adjacent work from contact with mortar.

B. Surface Preparation: Prepare substrate in accordance with manufacturer’s installation instructions for the type of substrate being covered.

3.3 INSTALLATION

A. Install and clean stone in accordance with manufacturer’s installation instructions for Standard Installation (Grouted Joint) or Jointless/Dry-Stacked installation as specified above.

B. Apply repellent in accordance with repellent manufacturer’s application instructions.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Request a Manufacturer’s Field Service Representative site visits for pre-construction meeting to review installation guidelines.

3.5 CLEANING

A. Reference Section 01 74 00 – Cleaning and Waste Management.

B. Remove protective coverings from adjacent work.

C. Cleaning Veneer Units:

1. Wash with soft bristle brush and water/granulated detergent solution.
2. Rinse immediately with clean water.

D. Removing Efflorescence:

1. Allow veneer to dry thoroughly.
2. Scrub with soft bristle brush and clean water.
3. Rinse immediately with clean water; allow to dry.

END OF SECTION 04 73 00

SECTION 05 03 71 - HISTORIC DECORATIVE METAL CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes historic treatment of decorative metal in the form of cleaning as follows:

1. Cleaning metal.
2. Removing paint.
3. Removing corrosion.
4. Priming for repainting.

B. Related Requirements:

1. Section 01 35 91 "Historic Treatment Procedures" for general historic treatment requirements.

1.3 DEFINITIONS

A. Low-Pressure Spray:

1. Pressure: 100 to 400 psi.
2. Flow Rate: 4 to 6 gpm.

B. Medium-Pressure Spray:

1. Pressure: 400 to 800 psi.
2. Flow Rate: 4 to 6 gpm.

C. High-Pressure Spray:

1. Pressure: 800 to 1200 psi.
2. Flow Rate: 4 to 6 gpm.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of decorative metal.
2. Review methods and procedures related to historic treatment of decorative metal including, but not limited to, the following:

    a. Verify historic treatment specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
    b. Materials, material application, and sequencing.
    c. Fire-protection plan.
    d. Decorative metal historic treatment program.
    e. Coordination with building occupants.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for product application and use.
2. Include test data substantiating that products comply with requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For historic treatment specialist, chemical-cleaner manufacturer, and paint-remover manufacturer.

B. Decorative Metal Historic Treatment Program: For cleaning historic decorative metalwork.

C. Preconstruction Test Reports: For chemical cleaning of and paint removal from historic decorative metal.

1.7 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic decorative metal cleaning specialist. Cleaning specialist shall be experienced in using mechanical and chemical methods on the types of metal surfaces indicated.

1. Single Specialist: Have the work of this Section, Section 05 03 73 "Historic Decorative Metal Refinishing", and Section 05 03 74 "Historic Decorative Metal Replication" performed by the same historic treatment specialist firm, meeting the specialist qualifications of those Sections.

B. Chemical-Cleaner Manufacturer Qualifications: A firm regularly engaged in producing metal cleaners that have been used for similar historic decorative metal applications with successful results and with factory-authorized service representatives who are available for consultation and Project-site inspection, preconstruction product testing, and on-site assistance.

C. Paint-Remover Manufacturer Qualifications: A firm regularly engaged in producing paint removers that have been used for similar historic decorative metal applications with successful results and with factory-authorized service representatives who are available for consultation and Project-site inspection, preconstruction product testing, and on-site assistance.

D. Decorative Metal Historic Treatment Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for historic treatment work, including each process or phase of cleaning decorative metal, related work, and the protection of surrounding materials and Project site.

1. If materials and methods other than those indicated are proposed for any phase of historic treatment work, add a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project.

E. Mockups: Prepare mockups of historic treatment cleaning processes on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution. Prepare mockups so they are inconspicuous.

1. Cleaning: Prepare an area approximately 2 sq. ft for each process on each type of metal indicated for treatment.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified historic treatment specialist or one or more chemical-cleaner and paint-remover manufacturers to perform preconstruction testing on each type of historic metal.

1. Use test areas as indicated and representative of proposed materials and existing construction.
2. Propose changes to materials and methods to suit Project.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with historic treatment of decorative metal only when existing and forecasted weather conditions are within the environmental limits set by each manufacturer's written instructions and specified requirements.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F.

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 1/2 cup of laundry detergent, and 20 quarts of hot water for every 5 gal. of solution required.

D. Nonacidic Liquid Chemical Cleaner: Manufacturer's standard mildly alkaline liquid cleaner, formulated for removing organic soiling from ordinary building materials including polished stone, brick, copper, brass, bronze, aluminum, stainless steel, plastics, wood, and glass.

E. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

2.2 PAINT REMOVERS

A. Alkaline Paste Paint Remover: Manufacturer's standard alkaline paste or gel formulation for removing paint from metals, and containing no methylene chloride.

B. Covered or Skin-Forming Alkaline Paint Remover: Manufacturer's standard covered or skin-forming alkaline paste or gel formulation for removing paint from metal, and containing no methylene chloride.

C. Solvent-Type Paste Paint Remover: Manufacturer's standard water-rinsable, solvent-type paste or gel formulation for removing paint from metals.

D. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinsable, solvent-type paste, gel, or foamed emulsion formulation for removing paint from metals; and containing no methanol or methylene chloride.

E. Covered, Solvent-Type Paste Paint Remover: Manufacturer's standard, low-odor, covered, water-rinsable, solvent-type paste or gel formulation for removing paint from metals; and containing no methanol or methylene chloride.

2.3 MISCELLANEOUS MATERIALS

A. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, glazed masonry, and polished stone surfaces from damaging effects of acidic and alkaline cleaners.

B. Masking Tape: Nonstaining, nonabsorbent material; compatible with chemical solutions being used and substrate surfaces; and that will easily come off entirely, including adhesive.

C. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.
2. Little possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.

5. Do not use products or tools that could do the following:

   a. Remove, alter, or in any way harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in the Contract.
   b. Leave an unintended residue on surfaces.

2.4 FERROUS METAL PRIMERS

A. Repair Primer: Manufacturer's standard, rust-inhibiting, fast-curing, lead- and chromate-free, universal primer, compatible with firmly adhered existing paint and applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry-film thickness.

B. Finish Primer: Primer complying with applicable requirements in Section 09 91 13 “Exterior Painting” and Section 09 91 23 “Interior Painting” for finish painting of primed historic metal.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT SPECIALIST

A. Historic Treatment Specialist Firms: Subject to compliance with requirements.

3.2 PROTECTION

A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.

   1. Cover adjacent surfaces with materials that are proven to resist chemical solutions being used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
   2. Do not apply chemical solutions during winds of sufficient force to spread them to unprotected surfaces.
   3. Neutralize alkaline and acid wastes before disposal.
   4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

3.3 HISTORIC DECORATIVE METAL CLEANING, GENERAL

A. Have historic decorative metal cleaning performed by a historic treatment specialist.

B. Cleaning Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 20 feet away by Architect.

C. Execution of the Work: In cleaning historic items, disturb them as minimally as possible and as follows:

   1. Remove deteriorated coatings and corrosion.
   2. Sequence work to minimize time before protective coatings are reapplied.
   3. Clean items in place unless otherwise indicated.

D. Mechanical Coating Removal: Use most gentle mechanical methods, such as scraping and wire brushing, that will not abrade metal substrate. Do not use abrasive methods such as sanding or power tools except as indicated as part of the historic treatment program and approved by Architect.

E. Repaint: Where indicated, prepare painted decorative metal by cleaning surface, removing less than firmly adhered existing paint, sanding edges smooth, and priming for painting as specified.

3.4 CLEANING

A. Use only those methods indicated for each type of decorative metal and its location.

1. Brushes: If using wire brushes, use brushes of same base metal composition as metal being treated. Use brushes that are resistant to chemicals being used.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.

    a. Equip units with pressure gages.
    b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
    c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
    d. For high-pressure water-spray application, use fan-shaped spray that disperses water at an angle of at least 40 degrees.
    e. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F at flow rates indicated.

3. Uniformity: Perform each cleaning method in a manner that results in uniform coverage of all surfaces, including corners, contours, and interstices, and that produces an even effect without streaks or damaging surfaces.
4. Protection: After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

B. Water Cleaning: Clean with cold water applied by low-pressure spray. Supplement with natural-fiber or plastic bristle brush. Use small brushes to remove soil from joints and crevices.

C. Detergent Cleaning:

1. Wet surface with [cold][hot] water applied by low-pressure spray.
2. Scrub surface with detergent solution and natural-fiber or plastic bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. Rinse with cold water applied by low-pressure spray to remove detergent solution and soil.
4. Repeat cleaning procedure where needed if required to produce cleaning effect established by mockup.

D. Nonacidic Liquid Chemical Cleaning: Apply chemical cleaner to surfaces according to chemical-cleaner manufacturer's written instructions.

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
4. Non-Ferrous Metals: Rinse with cold water applied by low-pressure spray to remove chemicals and soil.
5. Ferrous Metals: Do not rinse ferrous metals with water; neutralize chemical cleaner on ferrous metals as recommended in writing by manufacturer. Dry immediately with clean soft cloths. Follow direction of grain in metal.
6. Repeat cleaning procedure where needed if required to produce cleaning effect established by mockup. Do not repeat more than once.

E. Chemical Rust Removal:

1. Remove loose rust scale with approved abrasives for ferrous metal cleaning.
2. Apply rust remover with brushes or as recommended in writing by manufacturer.
3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as

determined by preconstruction testing. Do not allow extended dwell time.
4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.
5. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

F. Mechanical Rust Removal:

1. Remove rust with approved abrasives for ferrous metal cleaning.
2. Wipe off residue with mineral spirits and either steel wool or soft rags.
3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

3.5 PAINT REMOVAL

A. Use only those paint-removal methods indicated for each type of decorative metal.

1. Application: Apply paint removers according to paint-remover manufacturer's written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

a. Apply materials to all surfaces, corners, contours, and interstices, to provide a uniform final appearance without streaks.
b. After work is complete, remove protection no longer required. Remove tape and adhesive marks.

2. Brushes: If using wire brushes, use brushes of same base metal composition as metal being treated. Use brushes that are resistant to chemicals being used.
3. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.

a. Equip units with pressure gages.
b. Unless otherwise indicated, hold spray nozzle at least 6 inches from surface and apply material in horizontal, back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.
c. For chemical spray application, use low-pressure tank or chemical pump suitable for chemical indicated, equipped with cone-shaped spray.
d. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
e. For high-pressure water-spray application, use fan-shaped spray tip that disperses water at an angle of at least 40 degrees.
f. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F at flow rates indicated.

B. Paint Removal with Alkaline Paste Paint Remover:

1. Remove loose and peeling paint using water, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted metal with brushes.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Rinse with cold water applied by low -pressure spray to remove chemicals and paint residue.
5. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
6. Repeat process if necessary to remove all paint.

C. Paint Removal with Covered or Skin-Forming Alkaline Paint Remover:

1. Remove loose and peeling paint using water, scrapers, stiff brushes, or a combination of these. Let

surface dry thoroughly.
2. Apply paint remover to dry, painted metal with brushes or as recommended in writing by manufacturer.
3. Apply cover according to manufacturer's written instructions.
4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
5. Scrape off paint and remover.
6. Rinse with cold water applied by low-pressure spray to remove chemicals and paint residue.
7. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
8. For spots of remaining paint, apply alkaline paste paint remover according to "Paint Removal with Alkaline Paste Paint Remover" Paragraph.

D. Paint Removal with Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using water, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply thick coating of paint remover to painted decorative metal with natural-fiber cleaning brush, deep-nap roller, or large paint brush. Apply in one or two coats according to manufacturer's written instructions.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Rinse with cold water applied by low-pressure spray to remove chemicals and paint residue.
5. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
6. Repeat process if necessary to remove all paint.

E. Paint Removal with Covered, Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using water, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted decorative metal with natural-fiber cleaning brush, deep-nap roller, or large paint brush; or as recommended in writing by manufacturer.
3. Apply cover according to manufacturer's written instructions.
4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
5. Scrape off paint and remover.
6. Rinse with cold water applied by low-pressure spray to remove chemicals and paint residue.
7. Use mechanical methods recommended in writing by manufacturer to remove remaining chemicals and paint residue.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.

B. Notify testing agency in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until inspectors have had reasonable opportunity to inspect work areas at locations of lift devices or scaffolding.

C. Manufacturer's Field Service: Engage chemical-cleaner and paint-remover manufacturers' factory-authorized service representatives for consultation and Project-site inspection, to perform preconstruction product testing, and to provide on-site assistance when requested by Architect.

3.7 PRIMING

A. Repair Primer: Apply immediately after completing a repair.

B. Finish Primer: Apply as soon after cleaning as possible.

3.8 HISTORIC DECORATIVE METAL CLEANING SCHEDULE

A. Treatment of Decorative Railing: Wrought-iron railing and gate.

1. Perform work in the field.
2. Paint Removal: Alkaline paste paint remover.
3. Finish Treatment: As specified elsewhere and shown on drawings.

B. Treatment of Decorative Railing: Cast-iron balustrade.

1. Perform work in the field.
2. Paint Removal: Alkaline paste paint remover.
3. Rust Removal: Mechanical.
4. Finish Treatment: As specified elsewhere and shown on drawings.

C. Treatment of Bronze Grille: Strip paint and coat grille.

1. Perform work in the field.
2. Paint Removal: Solvent-type paste paint remover.
3. Protective Coating: As specified elsewhere and shown on drawings.

END OF SECTION 05 03 71

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Structural steel.
2. Shrinkage-resistant grout.

B. Related Requirements:

1. Section 05 31 00 "Steel Decking" for field installation of shear stud connectors through deck.
2. Section 05 50 00 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame and other steel items not defined as structural steel.
3. Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting"

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Anchor rods.
4. Threaded rods.
5. Shop primer.
6. Galvanized-steel primer.
7. Galvanized repair paint.
8. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.

3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members and connections of the seismic-load-resisting system.
6. Indicate locations and dimensions of protected zones.
7. Identify demand-critical welds.
8. Identify members not to be shop primed.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand-critical welds.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural-steel materials, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shop Primers.
5. Shear stud connectors.
6. Non-shrink grout.

F. Survey of existing conditions.

G. Source quality-control reports.

H. Field quality-control reports.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator who has a minimum of 5 years experience and successful completion with similar type projects. A minimum of 5 references for projects of similar size within the past five years is to be submitted for verification.

B. Installer Qualifications: A qualified installer who has a minimum of 5 years experience and successful completion with similar type projects. A minimum of 5 references for projects of similar size within the past five years is to be submitted for verification.

C. Shop-Painting Applicators: Qualified applicator who has a minimum of 5 years experience and successful completion with similar type projects. A minimum of 5 references for projects of similar size within the past five years is to be submitted for verification.

D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:

1. ANSI/AISC 303.
2. ANSI/AISC 341.
3. ANSI/AISC 360.
4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992

B. Channels, Angles: ASTM A 36

C. Plate and Bar: ASTM A 36

D. Cold-Formed Hollow Structural Sections: ASTM A 500 structural tubing.

E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.

1. Weight Class: See Construction Drawings.

F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

A. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1 (Type 8.8-1), compressible-washer type with plain finish.

B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex round head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Plain or galvanized as indicated on the drawings.

C. Headed Anchor Rods: ASTM F 1554, Grade 36.

1. Configuration: Headed.
2. Nuts: ASTM A 563 (ASTM A 563M) [heavy-]hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
5. Finish: Plain or galvanized as indicated on the drawings.

D. Threaded Rods: ASTM A 36.

1. Nuts: ASTM A 563 heavy- hex carbon steel.
2. Washers: ASTM F 436 Type 1 carbon steel.
3. Finish: Plain or galvanized as indicated on the drawings.

2.4 RODS

A. Unheaded Anchor Rods: ASTM F1554, Grade 55, weldable.

1. Configuration: Straight.
2. Nuts: ASTM A563 (ASTM A563M) heavy-hex carbon steel.
3. Plate Washers: ASTM A36/A36M carbon steel.
4. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
5. Finish: Plain or Hot-dip zinc coating, ASTM A153/A153M, Class C as indicated on the drawings.

B. Headed Anchor Rods: ASTM F1554, Grade 55, weldable, straight.

1. Nuts: ASTM A563 (ASTM A563M) heavy-hex carbon steel.
2. Plate Washers: ASTM A36/A36M carbon steel.
3. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
4. Finish: Plain or Hot-dip zinc coating, ASTM A153/A153M, Class C as indicated on the drawings.

C. Threaded Rods: ASTM A36/A36M

1. Nuts: ASTM A63 (ASTM A563M) heavy-hex carbon steel.
2. Washers: ASTM F436 (ASTM F436M), carbon steel.
3. Finish: Plain or Hot-dip zinc coating, ASTM A153/A153M, Class C as indicated on the drawings.

2.5 PRIMER

A. Steel Primer:

1. Comply with Section 09 91 13 "Exterior Painting," Section 09 91 23 "Interior Painting," and Section 09 96 00 "High-Performance Coatings."
2. SSPC-Paint 23, latex primer.
3. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

B. Galvanized-Steel Primer:

1. Etching Cleaner: MPI#25, for galvanized steel.
2. Galvanizing Repair Paint: ASTM A780/A780M.

2.6 SHRINKAGE-RESISTANT GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.7 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 1.

F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.8 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Pretensioned.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels and/or shelf angles attached to structural-steel frame and located in exterior walls.

2.10 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces unless indicated to be painted.
6. Corrosion-resisting (weathering) steel surfaces.

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:

1. SSPC-SP 3.
2. SSPC-SP 6 (WAB)/NACE WAB-3 for steel to be left exposed with paint finish only.

C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.

D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.11 SOURCE QUALITY CONTROL

A. Testing Agency: Owner shall engage a qualified testing agency to perform shop tests and inspections.

1. Provide testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect and test shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

C. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E165/E165M.
2. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3. Ultrasonic Inspection: ASTM E164.
4. Radiographic Inspection: ASTM E94/E94M.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrink-resistant grout.

A. Maintain erection tolerances of structural steel within ANSI/AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

C. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

D. Splice members only where indicated.

E. Do not use thermal cutting during erection.

F. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: Pretensioned.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 REPAIR

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.

B. Touchup Painting:

1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

3.6 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1) Liquid Penetrant Inspection: ASTM E165/E165M.
2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3) Ultrasonic Inspection: ASTM E164.
4) Radiographic Inspection: ASTM E94/E94M.

END OF SECTION 05 12 00

SECTION 05 31 00 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roof deck.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
2. Section 09 91 13 "Exterior Painting" for repair painting of primed deck and finish painting of deck.
3. Section 09 91 23 "Interior Painting" for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Roof deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.
2. Acoustical roof deck.

D. Research Reports: For steel deck, from ICC-ES.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ROOF DECK

A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 33 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.

a. Color: Manufacturer's standard.

2. Deck Profile: As indicated.
3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.
5. Span Condition: As indicated.

2.3 ACCESSORIES

A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), of same material and finish as deck, and of thickness and profile [indicated] [recommended by SDI Publication No. 31 for overhang and slab depth].

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch (1.52 mm) thick, with factory-punched hole of 3/8-inch (9.5-mm) minimum diameter.

J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.

K. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck, with 3-inch- (76-mm-) wide flanges and [level] [sloped] recessed pans of 1-1/2-inch (38-mm) minimum depth. For drains, cut holes in the field.

L. Galvanizing Repair Paint: ASTM A780/A780M.

M. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 INSTALLATION OF ROOF DECK

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:

1. Weld Diameter: 5/8 inch (16 mm), nominal.

2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated.
3. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 18 inches (457 mm), and as follows:

1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:

1. End Joints: Lapped 2 inches (51 mm) minimum or butted at Contractor's option.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches (305 mm) apart with at least one fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

G. Sound-Absorbing Insulation: Installation into topside ribs of deck as recommended by the acoustical deck manufacturer.

3.4 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Repair Painting:

1. Wire brush and clean rust spots, welds, and abraded areas on [both surfaces] [top surface] of prime-painted deck immediately after installation, and apply repair paint.
2. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
3. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
4. Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Prepare test and inspection reports.

END OF SECTION 05 31 00

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Load-bearing wall framing.
2. Exterior non-load-bearing wall framing.
3. Interior non-load-bearing wall framing.
4. Roof rafter framing.
5. Ceiling joist framing.
6. Soffit framing.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
2. Section 09 21 16.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies, with height limitations.
3. Section 09 22 16 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Cold-formed steel framing materials.
2. Load-bearing wall framing.
3. Exterior non-load-bearing wall framing.
4. Interior non-load-bearing wall framing.
5. Vertical deflection clips.
6. Single deflection track.
7. Double deflection track.
8. Drift clips.
9. Ceiling joist framing.
10. Soffit framing.
11. Post-installed anchors.
12. Power-actuated anchors.
13. Sill sealer gasket.
14. Sill sealer gasket/termite barrier.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated-Design Submittal: For cold-formed steel framing.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Certificates: For each type of code-compliance certification for studs and tracks.

D. Research Reports:

1. For nonstandard cold-formed steel framing **post-installed anchors and power-actuated fasteners**, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
2. For sill sealer gasket/termite barrier, showing compliance with ICC-ES AC380.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, or the Steel Stud Manufacturers Association.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

E. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated on Drawings
2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

a. Exterior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height.
b. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft. (239 Pa).
c. Roof Rafter Framing: Vertical deflection of 1/240 of the horizontally projected span for live loads.
d. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue

strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).

4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

   a. Upward and downward movement of **3/4 inch (19 mm)**.

5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:

1. Floor and Roof Systems: AISI S210.
2. Wall Studs: AISI S211.
3. Headers: AISI S212.
4. Lateral Design: AISI S213.

2.2 COLD-FORMED STEEL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: As required by structural performance.
2. Coating: G60 (Z180), A60 (ZF180), AZ50 (AZM150).

B. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As required by structural performance.
2. Coating: G60 (Z180).

2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
2. Flange Width: 1-5/8 inches (41 mm.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
2. Flange Width: 1-1/4 inches (32 mm).

C. Vertical Deflection Clips: Manufacturer's standard **bypass** or **head** clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
2. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures and 1 inch (25 mm) plus twice the design gap for other applications.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

a. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm.
b. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures and 1 inch (25 mm) plus twice the design gap for other applications.

2. Inner Track: Of web depth indicated, and as follows:

a. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
b. Flange Width: Dimension equal to sum of outer deflection track flange width plus 1 inch (25 mm).

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.4 INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
2. Flange Width: 1-5/8 inches (41 mm

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches (32 mm).

C. Vertical Deflection Clips: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
2. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures and 1 inch (25 mm) plus twice the design gap for other applications.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

a. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
b. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures and 1 inch (25 mm) plus twice the design gap for other applications.

2. Inner Track: Of web depth indicated, and as follows:

a. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).

b. Flange Width: Dimension equal to sum of outer deflection track flange width plus 1 inch (25 mm).

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.5 CEILING JOIST FRAMING

A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with standard holes, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
2. Flange Width: 1-5/8 inches (41 mm), minimum.

2.6 SOFFIT FRAMING

A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
2. Flange Width: 1-5/8 inches (41 mm).

2.7 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole-reinforcing plates.
11. Backer plates.

2.8 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.

C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58, or ICC-ES AC308 as appropriate for the substrate.

1. Uses: Securing cold-formed steel framing to structure.
2. Type: Torque-controlled expansion anchor.
3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.

4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy **Group 1 (A1)** stainless-steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.9 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780/A780M.

B. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.

D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

E. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch (6 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

F. Sill Sealer Gasket/Termite Barrier: Minimum 68-mil (1.7-mm) nominal thickness, self-adhering sheet consisting of 64 mils (1.6 mm) of rubberized asphalt laminated on one side to a 4-mil- (0.10-mm-) thick, polyethylene-film reinforcement, and with release liner on adhesive side; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.

1. Physical Properties:

a. Peel Adhesion: 17.0 lb/in of width (2.9 N/mm of width) when tested in accordance with ASTM D412.
b. Low-Temperature Flexibility: Pass at minus 25 deg F (minus 32 deg C) when tested in accordance with)ASTM D146/D146M.
c. Water Vapor Permeance: 0.05 perm (0.44 ng/Pa x s x sq. m) maximum when tested in accordance with ASTM E96/E96M, Method B.
d. Resistance to Termite Penetration: Comply with ICC-ES AC380.

2.10 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.

C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

C. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

E. Install sill sealer gasket/termite barrier in accordance with manufacturer's written instructions at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 07 21 00 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 INSTALLATION OF EXTERIOR NONLOADBEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to **top and** bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches (406 mm).

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to **bypassing** and **infill** studs and anchor to building structure.
4. Connect drift clips to cold-formed steel framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated **on Shop Drawings** but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within **18 inches (450 mm)** of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

1. Install solid blocking at centers indicated on Shop Drawings.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INSTALLATION OF INTERIOR NONLOADBEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches (406 mm).

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to studs and anchor to building structure.
4. Connect drift clips to cold-formed steel metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within **18 inches (450 mm)** of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

1. Install solid blocking at centers indicated on Shop Drawings.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 INSTALLATION OF JOIST FRAMING

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.

1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections.

C. Space joists not more than 2 inches (51 mm) from abutting walls, and as follows:

1. Joist Spacing: 16 inches (406 mm).

D. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.

E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement.

1. Install web stiffeners to transfer axial loads of walls above.

F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:

1. Joist-Track Solid Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
2. Combination Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.7 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.8 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.9 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 40 00

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel framing and supports for operable partitions.
2. Steel framing and supports for overhead doors and grilles.
3. Steel framing and supports for countertops.
4. Steel framing and supports for equipment.
5. Steel tube reinforcement for low partitions.
6. Steel framing and supports for mechanical and electrical equipment.
7. Steel framing and supports for applications where framing and supports are not specified in other Sections.
8. Slotted channel framing.
9. Metal ladders.
10. Metal ship ladders.
11. Metal floor plate and supports.
12. Miscellaneous steel trim including steel angle corner guards steel edgings and loading-dock edge angles.
13. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Requirements:

1. Section 04 20 00 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
2. Section 05 12 00 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.
3. Section 07 72 00 "Roof Accessories" for roof hatches and non-penetrating safety rails.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Fasteners.
3. Shop primers.
4. Shrinkage-resisting grout.
5. Prefabricated building columns.
6. Slotted channel framing.
7. Manufactured metal ladders.
8. Metal ship ladders.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Steel framing and supports for operable partitions.
2. Steel framing and supports for overhead doors and grilles.
3. Steel framing and supports for countertops.
4. Steel framing and supports for equipment.
5. Steel tube reinforcement for low partitions.
6. Steel framing and supports for mechanical and electrical equipment.
7. Steel framing and supports for applications where framing and supports are not specified in other Sections.
8. Slotted channel framing.
9. Metal ladders.
10. Metal floor plate and supports.
11. Miscellaneous steel trim including steel angle corner guards steel edgings and loading-dock edge angles.
12. Loose steel lintels.
13. Metal downspout boots.

C. Delegated-Design Submittal: For ladders and ship ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.

B. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.

C. Welding certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

E. Research Reports: For post-installed anchors.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design ladders.

B. Structural Performance of Ladders and Ship Ladders: Ladders and Ship Ladders shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C) , ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Stainless Steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 304 .

D. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304 .

E. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

F. Rolled-Stainless Steel Floor Plate: ASTM A793.

G. Abrasive-Surface Floor Plate: Steel plate with abrasive granules rolled into surface or with abrasive material metallically bonded to steel.

1. Source Limitations: Obtain floor plate from single source from single manufacturer.

H. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

I. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

J. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: 1-5/8 by 1-5/8 inches.
2. Material: Galvanized steel, ASTM A653/A653M, commercial steel, Type B structural steel, Grade 3, with G90 coating; 0.108-inch nominal thickness.
3. Material: Cold-rolled steel, ASTM A1008/A1008M, commercial steel, Type B structural steel, Grade 33; 0.0966-inch minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel hot-dip galvanized after fabrication.

K. Aluminum Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless steel fasteners for fastening aluminum stainless steel or nickel silver.
2. Provide bronze fasteners for fastening bronze.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ASTM F568M, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, (ASTM A563M, Class 10S3) heavy-hex carbon-steel nuts; and where indicated, flat washers.

D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593 (ASTM F738M); with hex nuts, ASTM F594 (ASTM F836M); and, where indicated, flat washers; Alloy Group 1 (A1).

E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

G. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.

H. Post-Installed Anchors: Torque-controlled expansion anchors .

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

I. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting." Section 09 91 23 "Interior Painting."

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.

D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

G. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, non-staining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

H. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Fabricate supports for operable partitions from continuous steel beams of sizes recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Galvanize miscellaneous framing and supports where indicated.

E. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 METAL LADDERS

A. General:

1. Comply with ANSI A14.3 , except for elevator pit ladders.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:

1. Space siderails 18 inches (457 mm) apart unless otherwise indicated.
2. Siderails: Continuous, 1/2-by-2-1/2-inch (12.7-by-64-mm) steel flat bars, with eased edges.
3. Rungs: 1-inch- (25-mm-) diameter , steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
7. Source Limitations: Obtain nonslip surfaces from single source from single manufacturer.
8. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.
9. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
10. Galvanize exterior ladders, including brackets.
11. Prime interior ladders, including brackets and fasteners, with zinc-rich primer.

2.8 METAL SHIP LADDERS

A. Basis-of-Design: Provide Precision Ladders' aluminum ship stair, or approved equal. (Dimensions and vertical height requirements to be field verified.)

B. Provide metal ship ladders where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.

1. Treads shall be not less than 5 inches (127 mm) exclusive of nosing or less than 8-1/2 inches (216 mm) including the nosing, and riser height shall be not more than 9-1/2 inches (241 mm).
2. Fabricate ship ladders, including railings, from aluminum.
3. Fabricate treads and platforms from pressure-locked aluminum bar extruded-aluminum plank grating. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.
4. Provide cage and crossover as required on roof ladders.
5. Comply with applicable railing requirements in Section 05 52 13 "Pipe and Tube Railings."

    a. Provide manufacturer's standard, code-compliant handrails.

2.9 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize and prime exterior miscellaneous steel trim.

D. Prime exterior miscellaneous steel trim with zinc-rich primer.

2.10 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize bearing and leveling plates.

C. Prime plates with zinc-rich primer.

2.11 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.12 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.13 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer primers specified in Section 09 91 13 "Exterior Painting" primers specified in Section 09 91 23 "Interior Painting" unless indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Items Indicated to Receive Primers Specified in Section 09 96 00 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
5. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.14 ALUMINUM FINISHES

A. As-Fabricated Finish: AA-M12.

B. Clear Anodized Finish.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for ceiling hung toilet partitions operable partitions overhead doors and overhead grilles securely to, and rigidly brace from, building structure.

C. Anchor shelf angles securely to existing construction with expansion anchors anchor bolts through bolts.

D. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

E. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installation of Bearing and Leveling Plates" Article.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLATION OF BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 REPAIRS

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05 50 00

SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel pipe and tube railings for interior construction. Decorative steel pipe and tube railings are as shown on drawings.
2. Aluminum railings.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.
3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.

a. Show method of connecting and finishing members at intersections.

D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

D. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

E. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. ASW D1.2/D1.2M, “Structural Welding Code – Aluminum.”

B. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including structural analysis, preconstruction testing, field testing, and in-service performance.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

C. Mock-ups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockups for each form and finish of railing consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 24 inches (600 mm) in length.

D. Pre-Installation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Steel Pipe and Tube Railings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Julius Blum & Co., Inc.
b. Pisor Industries, Inc.
c. Wagner, R & B, Inc.

B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C, material surfaces).

2.3 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

2.4 STEEL AND IRON

A. Tubing: ASTM A 500 (cold formed).

B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide galvanized finish for exterior installations and where indicated.

C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.5 ALUMINUM RAILINGS

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

B. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

C. Tubing: ASTM B221 (ASTM B221M), Alloy 6063-T5/T52.

D. Pipe: ASTM B429/B429M, Alloy 6063-T6.

1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.

E. Drawn Seamless Tubing: ASTM B210/B210M, Alloy 6063-T832.

F. Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.

G. Castings: ASTM B26/B26M, Alloy A356.0-T6.

2.6 FASTENERS

A. General: Provide the following:

1. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
2. Uncoated Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed; Type 304 stainless-steel fasteners where exposed.
3. Dissimilar Metals: Type 304 stainless-steel fasteners.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

E. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated or (exposed fasteners are the standard fastening method for railings indicated).

1. Provide tamper-resistant square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.

F. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

2.7 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For aluminum railings, provide type and alloy as recommended by producer of metal to be weled and as required for color match, strength and compatibility in fabricated items.

B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting," Section 09 91 23 "Interior Painting."

E. Intermediate Coats and Topcoats: Provide products that comply with Section 09 91 13 "Exterior Painting, "Section 09 91 23 "Interior Painting."

F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

G. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.8 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

J. Form Changes in Direction as Follows:

1. By bending or by inserting prefabricated elbow fittings.
2. By flush bends or by inserting prefabricated flush-elbow fittings.
3. By bending to smallest radius that will not result in distortion of railing member.

K. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of railing members with prefabricated end fittings.

M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

P. For railing posts set in concrete, provide steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

Q. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.9 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.10 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize steel railings, including hardware, after fabrication.
2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

D. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:

1. Exterior Railings: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Railings Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Railings Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Railings: SSPC-SP 3, "Power Tool Cleaning."

E. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with universal shop primer unless zinc-rich primer is indicated.

F. Field-Painted Finish

1. Color: As selected by Architect from manufacturer's full range.

G. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.

1. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.4 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.

C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

3.5 ATTACHING RAILINGS

A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.

C. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.6 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

C. Clean aluminum and stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 05 52 13

SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Framing with dimensional lumber.
2. Wood blocking, cants, and nailers.
3. Wood furring and grounds.
4. Wood sleepers.
5. Rooftop equipment bases and support curbs.
6. Utility shelving.
7. Plywood backing panels.

B. Related Requirements:

1. Section 06 16 00 "Sheathing" for sheathing, subflooring, and underlayment.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. Board Foot: Unit of measure for volume of lumber, equal to 144 cubic inches.

E. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NHLA: National Hardwood Lumber Association.
3. NLGA: National Lumber Grades Authority.
4. SPIB: The Southern Pine Inspection Bureau.
5. WCLIB: West Coast Lumber Inspection Bureau.
6. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.

4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Powder-actuated fasteners.
5. Expansion anchors.
6. Metal framing anchors.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
4. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less, 19 percent for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat all miscellaneous carpentry, not requiring fire-retardant treatment, unless otherwise indicated.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

E. Application: Treat all miscellaneous carpentry unless otherwise indicated and items required to be fire-retardant treated in accordance with applicable code, including the following.

1. Framing for raised platforms.
2. Concealed blocking.
3. Roof framing and blocking.
4. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
5. Plywood backing panels.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber of any species.

C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, Exterior, AC, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

1. Plywood shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions by Grade: Construction or No. 2 grade.
1. Application: All interior partitions.
2. Species:
a. Southern pine or mixed southern pine; SPIB.
b. Northern species; NLGA.
c. Eastern softwoods; NeLMA.
d. Western woods; WCLIB or WWPA.

B. Framing Other Than Non-Load-Bearing Partitions by Grade: No. 2 grade.
1. Application: Framing other than interior partitions
2. Species:
a. Hem-fir (north); NLGA.
b. Southern pine; SPIB.
c. Douglas fir-larch; WCLIB or WWPA.
d. Spruce-pine-fir; NLGA.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Metal Framing: ASTM C 954, length as recommended by screw manufacturer for material being fastened.

F. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

G. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

2.8 METAL FRAMING ANCHORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cleveland Steel Specialty Co.
2. KC Metals Products, Inc.
3. Phoenix Metal Products, Inc.
4. Simpson Strong-Tie Co., Inc.
5. USP Structural Connectors.

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.

1. Use for interior locations unless otherwise indicated.

C. Hot-Dip Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.

1. Use for wood-preservative-treated lumber and where indicated.

D. Stainless-Steel Sheet: ASTM A 666, Type 304.

1. Use for exterior locations and where indicated.

2.9 MISCELLANEOUS MATERIALS

A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

C. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

E. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

F. Do not splice structural members between supports unless otherwise indicated.

G. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.

H. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking accurately fitted to close furred spaces.
2. Fire block concealed spaces of framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal (38-mm actual) thickness.

I. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

J. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

K. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

L. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal-size (19-by-38-mm actual-size) furring vertically at 16 inches (406 mm) 400 mm o.c.

3.4 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 53

SECTION 06 16 00 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
3. Parapet sheathing.
4. Subflooring.
5. Sheathing joint and penetration treatment.

B. Related Requirements:

1. Section 06 10 53 "Miscellaneous Rough Carpentry" for plywood backing panels.
2. Section 07 27 26 "Fluid-Applied Membrane Air Barrier" for water-resistive barrier applied over wall sheathing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
2. For air-barrier and water-resistant glass-mat gypsum sheathing, include manufacturer's technical data and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier and water-resistant glass-mat gypsum sheathing assemblies.

1. Show locations and extent of sheathing, accessories, and assemblies specific to Project conditions.
2. Include details for sheathing joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications:

1. For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
2. For testing and inspecting agency providing tests and inspections related to air-barrier and water-resistant glass-mat gypsum sheathing: an independent agency, qualified according to ASTM E329 for testing indicated, and certified by Air Barrier Association of America, Inc.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

B. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing Performance: Air-barrier and water-resistant glass-mat gypsum sheathing assembly, and seals with adjacent construction, shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations , tie-ins to installed waterproofing , tie-ins to other installed air barriers, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.2 WOOD PANEL PRODUCTS

A. Emissions: Products shall meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Violatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Thickness: As need to comply with requirements specified, not less than the thickness indicated.

C. Factory mark panels to indicate compliance with applicable standard.

2.3 WALL SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Georgia-Pacific Gypsum LLC.; DensGlass® Gold or comparable product by one of the following:

a. CertainTeed; SAINT-GOBAIN.
b. Gold Bond Building Products, LLC provided by National Gypsum Company.
c. USG Corporation.

2. Type and Thickness: Type X, 1/2 inch (12.7 mm) thick.
3. Size: 48 by 96 inches(1219 by 2438 mm) for vertical and horizontal installation.

2.4 ROOF SHEATHING

A. Glass-Mat Gypsum Roof Sheathing: ASTM C 1177/1177M.

1. Basis of Design: Provide Georgia-Pacific Gypsum Corporation; DensDeck® Prime or equal products subject to compliance with requirements by one of the following manufacturers:

a. CertainTeed Corporation
b. National Gypsum Company
c. United States Gypsum Co.

2. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick.
3. Size: 48 x 96 inches (1219 by 2438 mm) for vertical and horizontal installation.
4. Provide on both vertical and horizontal where sheathing is installed below roofing.

B. Plywood Sheathing: DOC PS 1, Exterior sheathing.

1. Span Rating: Not less than 24/0.
2. Nominal Thickness: Not less than 3/4 inch (19.05 mm).

2.5 PARAPET SHEATHING

A. Plywood Sheathing: DOC PS 1, Exterior sheathing.

1. Span Rating: Not less than 24/0.
2. Nominal Thickness: Not less than 1/2 inch (13 mm).

B. Glass-Mat Gypsum Roof Sheathing: ASTM C 1177/1177M.

1. Basis of Design: Provide Georgia-Pacific Gypsum Corporation; DensDeck® Prime or equal products subject to compliance with requirements by one of the following manufacturers:

a. CertainTeed Corporation
b. National Gypsum Company
c. United States Gypsum Co.

2. Type and Thickness: 1/4 inch (6.35 mm) thick.

2.6 SUBFLOORING

A. Plywood Subflooring: DOC PS 1, single-floor panels or sheathing.

1. Span Rating: not less than 24.
2. Nominal Thickness: Not less than 23/32 inch (18.3mm).

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof, parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.

1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C1002.
2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C954.

2.8 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Section 07 92 00 "Joint Sealants."

B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m) , of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
2. ICC-ES evaluation report for fastener.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, “Engineering Wood Construction Guide,” for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Subflooring:

a. Glue and nail to wood framing.
b. Screw to cold-formed metal framing.
c. Space panels 1/8 inch apart at edges and ends.

2. Wall and Roof Sheathing.

a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
b. Screw to cold-formed metal framing.
c. Space panels 1/8 inch apart at edges and ends.

3.3 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to cold-formed metal framing with screws.
2. Install panels with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
3. Install panels with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.

D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.

E. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

F. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing:

1. Install accessory materials according to sheathing manufacturer's written instructions and details to form a seal with adjacent construction, to seal fasteners, and ensure continuity of air and water barrier.

    a. Coordinate the installation of sheathing with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
    b. Install transition strip on roofing membrane or base flashing, so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate.

2. Connect and seal sheathing material continuously to air barriers specified under other Sections as well as to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
3. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
4. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply preformed silicone extrusion, so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3 inches (75 mm) of full contact over firm bearing to perimeter frames, with not less than 1 inch (25 mm) of full contact.

    a. Transition Strip: Roll firmly to enhance adhesion.
    b. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.

5. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of sheathing material with foam sealant.
6. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

7. Seal top of through-wall flashings to sheathing with an additional 6-inch- (150-mm-) wide, transition strip.
8. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
9. Repair punctures, voids, and deficient lapped seams in strips and transition strips extending 6 inches (150 mm) beyond repaired areas in strip direction.

END OF SECTION 06 16 00

SECTION 06 20 23 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior trim.
2. Interior wood base, wood chair rail trim, and casing.
3. Interior board paneling.
4. Interior stair and railing assemblies.
5. Setting materials and accessories.

B. Related Requirements:

1. Section 06 10 53 "Miscellaneous Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
2. Section 09 91 23 “Interior Painting” for priming and backpriming of interior finish carpentry.
3. Section 09 93 10 “Wood Stains and Transparent Finishes” for finishing of wood materials.

1.3 DEFINITIONS

A. MDF: Medium-density fiberboard.

B. MDO: Plywood with a medium-density overlay on the face.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

1. Include data for wood-preservative treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material.
2. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials to comply with requirements.
3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.
4. Include copies of warranties from chemical-treatment manufacturers for each type of treatment.

B. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.

C. Samples for Verification:

1. For each species and cut of lumber and panel products with nonfactory-applied finish, with half of exposed surface finished; 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.
2. For each finish system and color of lumber and panel products with factory-applied finish, 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification data: For architectural woodwork manufacturer.

B. Product Certificates: For the following:

1. Composite wood products.
2. Adhesives.

1.6 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
1. Build mockups of typical paneling as shown on drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation.

1. Protect materials from weather by covering with waterproof sheeting, securely anchored.
2. Provide for air circulation around stacks and under coverings.

B. Deliver interior finish carpentry materials only when environmental conditions comply with requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions comply with requirements specified for installation areas.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet-work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

C. Field Measurements: Where paneling is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
1. Locate concealed framing, blocking, and reinforcements that support paneling by field measurements before being enclosed/concealed by construction and indicate measurements on Shop Drawings.

D. Established Dimensions: Where paneling is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site,

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Low-Emitting Materials: Composite wood products shall comply with the testing and product requirements of the California Department of Health Services "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by grading agency.

C. Softwood Plywood: DOC PS 1.

D. Hardboard: ANSI A135.4.

E. MDF: ANSI A208.2, made with binder containing no urea-formaldehyde resin, Grade 130.

F. Melamine-Faced Particleboard: Particleboard complying with ANSI A208.1, Grade M-2, finished on both faces with thermally fused, melamine-impregnated decorative paper and complying with NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

1. Color: As selected by Architect from manufacturer's full range.

2.2 FIRE-RETARDANT-TREATED MATERIALS

A. General: For applications indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction, and comply with testing requirements; testing by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent respectively.

C. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not contain colorants, and provide materials that do not have marks from spacer sticks on exposed face.

D. Do not use material that does not comply with requirements for untreated material or is warped or discolored.

E. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.
2. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.

F. Application: All interior lumber and plywood.

2.3 INTERIOR TRIM

A. Hardwood Lumber Trim for Transparent Finish (Stain Finish):

1. Species and Grade: White maple; A Finish; NHLA.
2. Maximum Moisture Content: 10 percent.
3. Finger Jointing: Not allowed.
4. Gluing for Width: Not allowed.
5. Veneered Material: Use only for lumber trim wider than 6 inches (150 mm).
6. Face Surface: Surfaced (smooth).

7. Matching: Selected for compatible grain and color.
8. Stain finish or paint to match existing.
9. Profile to be selected by architect from manufacturer's full range to match existing moldings.

B. Hardwood Moldings for Transparent Finish (Stain Finish): WMMPA HWM 2, N-grade wood moldings made to patterns included in WMMPA HWM 1.

1. Species: White maple.
2. Kiln-dried softwood or MDF, with exposed surfaces veneered with species indicated, may be used in lieu of solid wood.
3. Maximum Moisture Content: 9 percent.
4. Finger Jointing: Not allowed.
5. Matching: Selected for compatible grain and color.
6. Stain finish or paint to match existing.
7. Profile to be selected by architect from manufacturer's full range to match existing moldings.

C. Moldings for Opaque Finish (Painted Finish): Made to patterns included in MMPA's "WM/Series Softwood Moulding Patterns."
1. Hardwood Moldings: MMPA WM 4, P-grade.
   a. Species: Aspen, basswood, cottonwood, gum, magnolia, soft maple, tupelo, or yellow poplar.
   b. Maximum Moisture Content: 9 percent.
2. Finger Jointing: Not allowed.

2.4 PANELING

A. Board Paneling, MMPA (Stain and Painted Finishes): Interior wood-board paneling complying with MMPA WM 9.

1. Species: White Maple, Clear No. 2 or better.
2. Maximum Moisture Content: 9 percent.
3. Finger jointing: Not allowed
4. Pattern: To match existing paneling.
5. Matching: Selected for compatible grain and color.
6. Stain finish or paint to match existing.
7. Pattern: V-joint or beaded to match existing paneling.

2.5 REPLACEMENT WOOD ITEMS

A. Replacement Wood Items: Replicated wood paneling, railings, and trim, custom fabricated from salvaged, sound, original wood, new wood, or a combination thereof.

1. Joint Construction: Joints matching existing joints.
2. Wood Cut: Match cut of existing wood.
3. Wood Members: Replicate existing wood members.
4. Hardware: Repair, refinish, and reuse existing unless otherwise indicated.

2.6 WOOD-REPAIR MATERIALS

A. Source Limitations: Obtain wood consolidant and wood-patching compound from single source from single manufacturer.

1. Wood-Patching Compound: Two-part, epoxy-resin, wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound designed for filling voids in damaged wood materials that have deteriorated due to weathering and decay. Compound capable of filling deep holes and spreading to featheredge.

2.7 MISCELLANEOUS MATERIALS

A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.

C. Installation Adhesive for Foam-Plastic Moldings: Product recommended for indicated use by foam-plastic molding manufacturer.

D. Paneling Adhesive: Comply with paneling manufacturer's written instructions for adhesives.

E. Multipurpose Construction Adhesive: Formulation, complying with ASTM D3498, that is recommended for indicated use by adhesive manufacturer.

G. Handrail Brackets: Extruded from aluminum with wall flange drilled for exposed anchor and with support arm for screwing to underside of rail. Sized to provide 1-1/2-inch (38-mm) clearance between handrail and wall.

2.8 FABRICATION

A. Back out or kerf backs of the following members, except those with ends exposed in finished work:

1. Interior standing and running trim, except shoe and crown molds.
2. Wood-board paneling.

B. Ease edges of lumber less than 1 inch (25 mm) in nominal thickness to 1/16-inch (1.5-mm) radius and edges of lumber 1 inch (25 mm) or more in nominal thickness to 1/8-inch (3-mm) radius.

C. Fill voids with filler; finish smooth and flush with adjacent surfaces.

D. Wipe off surfaces using mineral spirits and allow to dry.

E. Apply one coat sealer and two finish coats. Allow each coat to dry completely before applying subsequent coats.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound; warped; improperly treated or finished; inadequately seasoned; too small to fabricate with proper jointing arrangements; or with defective surfaces, sizes, or patterns.

B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials.

1. Use concealed shims where necessary for alignment.
2. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
3. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
4. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining interior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.
5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.4 INSTALLATION OF PANELING

A. Plywood Paneling: Select and arrange panels on each wall to minimize noticeable variations in grain character and color between adjacent panels.

1. Leave 1/4-inch (6-mm) gap to be covered with trim at top, bottom, and openings.
2. Install with uniform tight joints between panels.
3. Attach panels to supports with manufacturer's recommended panel adhesive and fasteners.
4. Space fasteners and adhesive as recommended by panel manufacturer.
5. Conceal fasteners to greatest practical extent.
6. Arrange panels with grooves and joints over supports.

a. Fasten to supports with nails of type and at spacing recommended by panel manufacturer.
b. Use fasteners with prefinished heads matching groove color.

B. Board Paneling: Install according to manufacturer's written instructions.

1. Arrange in random-width pattern suggested by manufacturer unless boards or planks are of uniform width.
2. Install in full lengths without end joints.
3. Stagger end joints in random pattern to uniformly distribute joints on each wall.
4. Install with uniform end joints with only end-matched (tongue-and-groove) joints within each field of paneling.
5. Install with uniform end joints. Locate end joints only over furring or blocking.
6. Select and arrange boards on each wall to minimize noticeable variations in grain character and color between adjacent boards.
7. Install with uniform tight joints between boards.
8. Fasten paneling by face nailing, setting nails, and filling over nail heads.
9. Fasten paneling with trim screws, set below face and filled.
10. Fasten paneling by blind nailing through tongues.
11. Fasten paneling with paneling system manufacturer's concealed clips.
12. Fasten paneling to gypsum wallboard with panel adhesive.

3.5 ADJUSTING

A. Replace interior finish carpentry that is damaged or does not comply with requirements.

1. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

B. Adjust joinery for uniform appearance.

3.6 CLEANING

A. Clean interior finish carpentry on exposed and semi-exposed surfaces.

B. Restore damaged or soiled areas and touch up factory-applied finishes if any.

3.7 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 06 20 23

SECTION 06 43 00 - WOOD STAIRS AND RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wood stairs and railings.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Site.

1.4 ACTION SUBMITTALS

A. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For the following:

1. Composite wood and agrifiber products.
2. Adhesives.

B. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

B. Installer Qualifications: Fabricator of products.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver wood stairs and railings until painting and similar operations that could damage woodwork have been completed in installation areas. If wood stairs and railings must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install wood stairs and railings until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during the remainder of the construction period.

B. Field Measurements: Where wood stairs and railings are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where wood stairs and railings are indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that wood stairs and railings can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 WOOD STAIRS AND RAILINGS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

B. Grade: Custom.

C. Wood for Transparent Finish: Species and cut to match existing.

D. Finishes for Stair Parts: As follows:

1. Treads: To match existing.
2. Risers: To match existing
3. Stringers: To match existing.
4. Balusters: To match existing
5. Handrails: To match existing
6. Post Cap, Cove, and Other Moldings: To match existing

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (75 mm) wide.
2. Wood Moisture Content: 8 to 13 percent.

2.3 MISCELLANEOUS MATERIALS

A. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

2.4 FABRICATION

A. Fabricate wood stairs and railings to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.

B. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

2.5 SHOP FINISHING

A. General: Finish wood stairs and railings at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. General: Drawings indicate items that are required to be shop finished. Finish such items at fabrication shop as specified in this Section. Refer to Section 09 93 00 "Staining and Transparent Finishing" for field finishing architectural woodwork not indicated to be shop finished.

C. Shop Priming: Shop apply the prime coat including backpriming, if any, for transparent-finished items specified to be field finished. Refer to Section 099123 "Interior Painting" and Section 099300 "Staining and Transparent Finishing" for material and application requirements.

D. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork.

E. Transparent Finish:

1. Grade: Custom.
2. Finish: System - 4, water-based latex acrylic.
3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
4. Staining: Match existing adjacent wood railing.
5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
6. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
7. Sheen: Satin, 31-45, match existing gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition wood stairs and railings to average prevailing humidity conditions in installation areas.

B. Before installing wood railings, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install wood railings to comply with same grade as item to be installed.

B. Assemble wood railings and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Railings:

1. General: Install rails with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) variation from a straight line.
2. Stair Rails: Glue and dowel or pin balusters to treads and railings, and railings to newel posts.
3. Wall Rails: Support rails on indicated metal brackets securely fastened to wall framing.

D. Touch up finishing work specified in this Section after installation of wood stairs and railings. Fill nail holes with matching filler where exposed.

1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.

E. Refer to Section 099300 "Staining and Transparent Finishing" for final finishing of installed wood railings not indicated to be shop finished.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective wood stairs and railings, where possible, to eliminate functional and visual defects; where not possible to repair, replace wood stairs and railings. Adjust joinery for uniform appearance.

B. Clean wood stairs and railings on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 06 43 00

SECTION 06 48 00 – WOOD FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior frames and jambs.
2. Interior frames and jambs.
3. Shop priming wood frames and jambs.
4. Shop finishing wood frames and jambs.

B. Related Requirements:

1. Section 06 10 53 "Miscellaneous Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
2. Section 09 91 3 “Exterior Painting” for priming and backpriming of exterior finish carpentry.
3. Section 09 91 23 “Interior Painting” for priming and backpriming of interior finish carpentry.

C. ACTION SUBMITTALS

D. Product Data: For each type of product, including fire-retardant-treated materials and finishing materials and processes.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

E. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of concealed blocking and reinforcement specified in other Sections.
3. Apply WI Certified Compliance Program label to Shop Drawings.
4. Apply AWI Quality Certification Program label to Shop Drawings.

F. Samples for Initial Selection:

1. Shop-applied transparent finishes.
2. Shop-applied opaque finishes.

G. Samples for Verification:

1. Lumber for transparent finish, not less than 5 inches (125 mm) wide by 12 inches (300 mm) long, for each species and cut, finished on one side and one edge.
2. Lumber with shop-applied opaque finish, 5 inches (125 mm) wide by 12 inches (300 mm) long for, for each finish system and color, with one-half of exposed surface finished.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator.

B. Product Certificates: For each type of product.

C. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

D. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.4 MOCKUPS

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of typical wood frames as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver wood frames until operations that could damage wood frames have been completed in installation areas. If wood frames must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified for installation areas.

1.6 FIELD CONDITIONS

A. Weather Limitations for Exterior Work: Proceed with installation of exterior wood frames only when existing and forecasted weather conditions permit work to be performed and at least one coat of specified finish to be applied without exposure to rain, snow, or dampness.

B. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet-work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

C. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

D. Field Measurements: Where wood frames are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support wood frames by field measurements before being enclosed, and indicate measurements on Shop Drawings.

1.7 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that wood frames can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 WOOD FRAMES, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of wood frames indicated for construction, finishes, installation, and other requirements.

1. Provide labels and certificates from AWI certification program indicating that woodwork, including installation, complies with requirements of grades specified.

2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

2.2 EXTERIOR FRAMES AND JAMBS FOR TRANSPARENT FINISH

A. Grade: Premium.

B. Wood Species: Match species of existing type of wood component or assembly unless otherwise indicated.

C. EXTERIOR FRAMES AND JAMBS FOR OPAQUE FINISH

D. Grade: Premium.

E. Wood Species: Match species of existing type of wood component or assembly unless otherwise indicated.

2.3 INTERIOR FRAMES AND JAMBS FOR TRANSPARENT FINISH

A. Grade: Premium.

B. Wood Species and Cut: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building unless otherwise indicated.

1. Species: Match species of existing type of wood component or assembly unless otherwise indicated.
2. Cut: Match cut of existing type of wood component or assembly unless otherwise indicated.
3. Provide split species on frames and jambs that face areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.

C. For frames or jambs wider than available lumber, use veneered construction. Do not glue for width.

D. Fire-Rated Interior Frames and Jambs: Products fabricated from fire-retardant particleboard or fire-retardant medium-density fiberboard with veneered exposed surfaces and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

1. Fire Rating: 20 minutes.

2.4 INTERIOR FRAMES AND JAMBS FOR OPAQUE FINISH

A. Grade: Premium.

B. Wood Species: Match species of existing type of wood component or assembly unless otherwise indicated

C. Fire-Rated Interior Frames and Jambs: Products fabricated from fire-retardant particleboard with veneered exposed surfaces or fire-retardant medium-density fiberboard and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

1. Fire Rating: 20 minutes, unless otherwise noted.

2.5 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of wood frame and quality grade specified unless otherwise indicated.

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches (75 mm) wide.
2. Wood Moisture Content for Exterior Materials: 9 to 15 percent.
3. Wood Moisture Content for Interior Materials: 5 to 10 percent.

B. Water-Repellent Preservative Treated Materials: Comply with AWPA N1 (dip, spray, flood, or vacuum-pressure treatment) for exterior wood frames indicated to receive water-repellent preservative treatment.

1. Preservative Chemicals: 3-iodo-2-propynyl butyl carbamate (IPBC), combined with an insecticide containing chloropyrifos (CPF).
2. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.
3. Extent of Water-Repellent Preservative Treatment: Treat all exterior wood frames unless otherwise indicated.

2.6 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

1. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

B. Fire-Retardant-Treated Lumber: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Kiln dry lumber after treatment to a maximum moisture content of 19 percent.

C. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.

1. For panels 3/4 inch (19 mm) thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, 1600 psi (11 MPa); modulus of elasticity, 300,000 psi (2070 MPa); internal bond, 80 psi (550 kPa); and screw-holding capacity on face and edge, 250 and 225 lbf (1100 and 1000 N), respectively.

D. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.

2.7 MISCELLANEOUS MATERIALS

A. Exterior Blocking, Shims, and Nailers: Softwood or hardwood lumber, pressure-preservative treated, fire-retardant treated, kiln dried to less than 15 percent moisture content.

1. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC3b.

a. Kiln dry lumber after treatment to a maximum moisture content of 19 percent.
b. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
c. Mark lumber with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee's (ALSC) Board of Review.

B. Interior Blocking, Shims, and Nailers: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.

C. Nails for Exterior Use: Aluminum, hot-dip galvanized, or stainless steel.

D. Screws for Exterior Use: Aluminum, hot-dip galvanized, or stainless steel.

E. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.

F. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

G. Adhesives: Do not use adhesives that contain urea formaldehyde.

H. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.8 FABRICATION

A. Fabricate wood frames to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Edges of Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.

2.9 SHOP PRIMING

A. Exterior Wood Frames for Opaque Finish: Shop prime with one coat of wood primer specified in Section 099113 "Exterior Painting."

B. Exterior Wood Frames for Transparent Finish: Shop seal with stain (if required), other required pretreatments, and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."

C. Interior Wood Frames for Opaque Finish: Shop prime with one coat of wood primer specified in Section 099123 "Interior Painting."

D. Interior Wood Frames for Transparent Finish: Shop seal with stain (if required), other required pretreatments, and first coat of finish as specified in Section 099310 "Wood Stains and Transparent Finishes."

E. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood frames, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood trim. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

2.10 SHOP FINISHING

A. General: Finish wood frames at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. General: Shop finish transparent-finished wood frames at fabrication shop as specified in this Section. Refer to Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for field finishing opaque-finished wood frames.

C. General: Drawings indicate items that are required to be shop finished. Finish such items at fabrication shop as specified in this Section. Refer to Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for field finishing wood frames not indicated to be shop finished.

D. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood frames, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood frames. Apply two coats to end-grain surfaces.

E. Transparent Finish for Exterior Frames: Comply with Section 099310 "Wood Staining and Transparent Finishes."

F. Opaque Finish for Exterior Frames: Comply with Section 099113 "Exterior Painting."

G. Transparent Finish for Interior Frames:

1. Grade: Same as item to be finished.
2. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
3. Staining: Match approved sample for color.
4. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
5. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
6. Sheen: Flat, 15-30 gloss units measured on 60-degree gloss meter per ASTM D 523.

H. Opaque Finish for Interior Frames:

1. Grade: Same as item to be finished.
2. Color: As selected by Architect from manufacturer's full range.
3. Sheen: Flat, 15-30 gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition wood frames to average prevailing humidity conditions in installation areas.

B. Before installing wood frames, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install wood frames to comply with same grade as item to be installed.

B. Assemble wood frames and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install wood frames level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut wood frames to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

F. Anchor wood frames to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.

1. For shop-finished items, use filler matching finish of items being installed.

G. Touch up finishing work specified in this Section after installation of wood frames. Fill nail holes with matching filler where exposed.

1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.

H. Refer to Section 099123 "Interior Painting" for final finishing of installed wood frames not indicated to be shop finished.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective wood frames, where possible, to eliminate functional and visual defects; where not possible to repair, replace wood frames. Adjust joinery for uniform appearance.

B. Clean wood frames on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 06 48 00

SECTION 07 01 50.19 - PREPARATION FOR RE-ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roof replacement preparation consisting of full roof tear-off of roof system at designated roof areas.

2. Removal of flashings and counterflashings.

3. Temporary roofing.

4. Removal and reinstallation of indicated components, accessories, and equipment.

B. Related Information:

1. Division 07 Section "Sheet Metal Flashing and Trim" for formed metal roof flashings and counterflashings.

2. Division 07 Section "Roof Specialties" for manufactured roof edge/fascia systems.

1.3 DESCRIPTION OF WORK

A. Re-roofing preparation Work consists of the following:

1. Preparation for Roof replacement:

a. Roof Area(s): A.

b. Existing Roof Type: Granular surfaced modified bituminous.

c. Existing Deck Type: Wood deck.

d. Roof tear-off.

e. Removal and reinstallation of indicated components, accessories, and equipment.

f. Removal of base flashings.

g. Temporary roof membrane.

2. Preparation for Roof replacement:

a. Roof Area(s): B.

b. Existing Roof Type: Granular surfaced modified bituminous.

c. Existing Deck Type: Structural insulated panels (SIP).

d. Roof tear-off.

e. Removal and reinstallation of indicated components, accessories, and equipment.

f. Removal of base flashings.

g. Temporary roof membrane.

1.4 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

1.5 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D1079 "Standard Terminology Relating to Roofing and Waterproofing" and applicable edition of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" and NRCA’s Glossary for definition of terms related to roofing work in this Section.

B. Existing Roofing System: Roofing system identified above, including roof covering/membrane, roof insulation, surfacing, and components and accessories between deck and roof covering/membrane.

C. Full Roof Tear-Off: Removal of existing membrane roofing system from deck.

D. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and reinstalled.

E. Existing to Remain: Existing items of construction that are not indicated to be removed.

F. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

G. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

H. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

1.6 PREINSTALLATION MEETINGS

A. Preliminary Roofing Conference: Before starting removal Work, conduct conference at Project site.

1. Coordinate with roofing preinstallation meetings specified in Division 07 roofing section(s).

2. Review methods and procedures related to roofing tear-off, including, but not limited to, the following:

a. Reroofing preparation, including roofing system manufacturer's written instructions.

b. Temporary protection requirements for existing roofing system components that are to remain.

c. Existing roof drains and roof drainage during each stage of reroofing, and roof-drain plugging and plug removal.

d. Construction schedule and availability of materials, Installer's personnel, equipment, and facilities needed to avoid delays.

e. Existing roof deck conditions and other conditions requiring Architect notification.

f. Existing roof deck removal procedures and Owner notifications.

g. Condition and acceptance of existing roof deck and base flashing substrate for reuse.

h. Structural loading limitations of roof deck during reroofing.

i. Base flashings, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that affect reroofing.

j. HVAC shutdown and sealing of air intakes.

k. Shutdown of fire-suppression, -protection, and -alarm and -detection systems.

l. Governing regulations and requirements for insurance and certificates if applicable.

1.7 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Temporary Roofing: Include Product Data and description of temporary roofing system. If temporary roof will remain in place, submit surface preparation requirements needed to receive permanent roof, and submit a letter from roofing membrane manufacturer stating acceptance of the temporary membrane and that its inclusion will not adversely affect the roofing system's resistance to fire and wind.

1.8 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For Installer.

B. Field Test Reports:

1. Fastener pull-out test report.

C. Digital Images or Videos: Show existing conditions of adjoining construction and site improvements, including exterior and interior finish surfaces, which might be misconstrued as having been damaged by reroofing operations. Submit before Work begins.

D. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property for environmental protection, for dust control and for noise control. Indicate proposed locations and construction of barriers.

E. Schedule of Re-Roofing Preparation Activities: Indicate the following:

1. Detailed sequence of re-roofing preparation work, with starting and ending dates for each activity. Ensure occupants' on-site operations are uninterrupted.

2. Interruption of utility services. Indicate how long utility services will be interrupted.

3. Coordination for shutoff, capping, and continuation of utility services.

4. Use of elevator and stairs.

5. Coordination of Owner's continuing occupancy of portions of existing building.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Installer of new membrane roofing system.

B. Regulatory Requirements:

1. Comply with governing EPA notification regulations before beginning membrane roofing removal.

2. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.10 PROJECT / FIELD CONDITIONS

A. Owner will occupy portions of building immediately below reroofing area.

1. Conduct reroofing so Owner's operations will not be disrupted.

2. Provide Owner with not less than 72 hours' written notice of activities that may affect Owner's operations.

3. Coordinate work activities daily with Owner so Owner can place protective dust or water leakage covers over sensitive equipment or furnishings, shut down HVAC and fire-alarm or -detection equipment if needed, and evacuate occupants from below the work area.

B. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.

C. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.

D. Conditions existing at time of inspection for bidding will be maintained by Owner as far as practical.

1. A roof moisture survey of existing roofing system is available for Contractor's reference.

2. The results of an analysis of test cores from existing roofing system are available for Contractor's reference.

3. Construction / Record Drawings for existing roofing system are provided for Contractor's convenience and information, but they are not a warranty of existing conditions. They are intended to supplement rather than serve in lieu of Contractor's own investigations. Contractor is responsible for conclusions derived from existing documents.

E. Limit construction loads on roof to rooftop equipment wheel loads and uniformly distributed loads not exceeding recommendations of Contractor's professional engineer based upon site inspection and analysis.

F. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.

1. Remove only as much roofing in one day as can be made watertight in the same day.

G. Daily Protection: Coordinate installation of roofing so insulation and other components of roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

H. Hazardous Materials: It is not expected that hazardous materials such as asbestos-containing materials will be encountered in the Work.

1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.

a. Obtain direction from Architect before proceeding with work in the affected area.

I. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 TEMPORARY PROTECTION MATERIALS

A. EPS Insulation: Molded (expanded) polystyrene, ASTM C578.

B. Plywood: NIST DOC PS 1, Grade CD, Exposure 1.

C. Oriented Strand Board (OSB): NIST DOC PS 2, Exposure 1.

2.2 DECK REPAIR/REPLACEMENT MATERIALS

A. Wood Roof Deck and Sheathing Components:

1. Wood Deck Material:

a. Comply with DOC PS 20 and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

b. Moisture Content: Provide wood decking with 19 percent maximum moisture content at time of dressing.

c. Match existing size, face surface and edge profile.

d. Decking Species: Balsam fir, Douglas fir-larch, Douglas fir-larch (North), hem-fir, hem-fir (North), southern pine, spruce pine-fir (North), western hemlock, or western hemlock (North).

e. Decking Grade: Commercial decking.

1) Grade Stamps: Factory mark each item with grade stamp of grading agency. Apply grade stamp to surfaces that will not be exposed to view.

f. Preservative Treatment: Pressure treat solid-sawn wood decking according to AWPA C31 with inorganic boron (SBX) and redry wood to 19 percent maximum moisture content.

g. Fasteners for Solid-Sawn Decking: Provide fastener size and type complying with decking standard for thickness of deck used.

1) Fastener Material: Hot-dip galvanized or stainless steel.

2. Roof Sheathing:

a. Plywood Roof Sheathing: APA-Rated Exterior, Structural I sheathing.

1) Span Rating: Not less than 32/16.

2) Nominal Thickness: Not less than 1/2 inch (13 mm).

b. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2, Use Category UC3b for exterior construction not in contact with the ground.

1) Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

2) Application: Treat wood decking and plywood sheathing materials, not requiring fire-retardant treatment, unless otherwise indicated.

c. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1) Application: Treat plywood sheathing and wood decking, required to be fire-retardant treated in accordance with applicable code.

3. Fasteners: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

a. For roof sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A 153M or Type 304 stainless steel.

1) Nails, Brads, and Staples: ASTM F1667.

2) Power-Driven Fasteners: NES NER-272.

3) Wood Screws: ASME B18.6.1.

b. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

1) For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117.

2.3 TEMPORARY ROOFING MATERIALS

A. Design and selection of materials for temporary roofing are responsibilities of Contractor.

2.4 TEMPORARY ROOF DRAINAGE

A. Design and selection of materials for temporary roof drainage are responsibilities of the Contractor.

2.5 AUXILIARY RE-ROOFING MATERIALS

A. General: Auxiliary reroofing preparation materials recommended by roofing system manufacturer for intended use and compatible with components of new membrane roofing system.

B. Fasteners: Factory-coated steel fasteners with metal or plastic plates listed in FM Approvals' RoofNav, and acceptable to new roofing system manufacturer.

C. Metal Flashing Sheet: Metal flashing sheet is specified in Division 07 Section "Sheet Metal Flashing and Trim."

PART 3 - EXECUTION

3.1 PREPARATION, GENERAL

A. Protection of In-Place Conditions: Protect existing roofing system that is indicated not to be reroofed.

1. Protect existing roofing system that is indicated not to be reroofed.

2. Loosely lay 1 inch (25 mm) minimum thick, molded expanded polystyrene (EPS) insulation over the roofing membrane in areas indicated.

a. Loosely lay 15/32-inch (12-mm) plywood or OSB panels over EPS. Extend EPS past edges of plywood or OSB panels a minimum of 1 inch (25 mm).

3. Limit traffic and material storage to areas of existing roofing membrane that have been protected.

4. Maintain temporary protection and leave in place until replacement roofing has been completed. Remove temporary protection on completion of reroofing.

B. Seal or isolate windows that may be exposed to airborne substances created in removal of existing materials.

C. Shut off rooftop utilities and service piping before beginning the Work.

D. Test existing roof drains, gutters and downspouts to verify that they are not blocked or restricted.

1. Immediately notify Architect of any blockages or restrictions.

E. Coordinate with Owner to shut down air-intake equipment in the vicinity of the Work.

1. Cover air-intake louvers before proceeding with reroofing work that could affect indoor air quality or activate smoke detectors in the ductwork.

F. Pollution Control: Comply with environmental regulations of authorities having jurisdiction. Limit spread of dust and debris.

1. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

2. Remove debris from building roof by chute, hoist, or other device that will convey debris to grade level.

G. Refrigerant: Before starting re-roofing preparation, remove refrigerant from mechanical equipment to be removed and reinstalled, according to 40 CFR 82 and regulations of authorities having jurisdiction. By Mechanical Contractor.

H. Temporary Weather Protection: During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.

I. Roof Drainage Protection: Maintain roof drainage in functioning condition to ensure roof drainage at end of each workday.

1. Prevent debris from entering or blocking roof drainage and conductors.

a. Use plugs specifically designed for this purpose.

b. Remove plugs at end of each workday, when no work is taking place, or when rain is forecast.

2. If roof drainage components are temporarily blocked or unserviceable due to roofing system removal or partial installation of new membrane roofing system, provide alternative drainage method to remove water and eliminate ponding.

    a. Do not permit water to enter into or under existing membrane roofing system components that are to remain.

3.2 ROOF TEAR-OFF

A. Notify Owner each day of extent of roof tear-off proposed for that day.

B. Lower removed roofing materials to ground and onto lower roof levels, using dust-tight chutes or other acceptable means of removing materials from roof areas.

C. Remove walkways, pavers and accessories from roofing membrane.

1. Store and protect pavers and accessories for reuse in manner not to exceed structural loading limitations of roof deck.

2. Discard cracked pavers.

D. Roof Drainage: Remove roof drainage items indicated for removal.

E. Remove Flashings: Remove roof flashings indicated for removal.

1. Remove base flashings and counter flashings.

2. Remove perimeter edge flashings and gravel stops.

3. Remove expansion-joint covers.

4. Remove flashings at pipes, curbs, mechanical equipment, and other penetrations.

F. Full Roof Tear-Off: Where indicated on Drawings, remove existing roofing membrane and other membrane roofing system components down to the deck.

1. Remove cover boards and roof insulation.

2. Remove fasteners from deck or cut fasteners off slightly above deck surface.

G. Roof Edge Specialties: Replace existing perimeter metal systems with new perimeter metal systems.

1. New perimeter metal systems (fascia and coping) are specified in Division 07 Section "Roof Specialties."

H. Inspect wood blocking, curbs, and nailers for deterioration and damage.

1. Remove deteriorated or unsuitable wood blocking, curbs, and nailers.

2. Replace existing wood components that exhibit signs of deterioration or other conditions detrimental to securement of roofing system components, including roof edge flashings.

3. Reuse of Existing Wood Nailers: Permitted where type, size and securement are in accordance with ANSI/SPRI/FM 4435 ES-1 and Factory Mutual Loss Prevention Data Sheet 1-49; and existing wood nailers exhibit no signs of deterioration or other conditions detrimental to securement of new roofing system in conformance with specified requirements.

3.3 DECK PREPARATION

A. Inspect deck after tear-off of membrane roofing system.

B. Verify that deck is sound and dry.

C. If broken or loose fasteners that secure deck panels to one another or to structure are observed or if deck appears or feels inadequately attached, immediately notify Architect. Do not proceed with installation until directed by Architect.

D. Unsuitable Deck: If deck surface is not suitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify Architect.

1. Do not proceed with installation until directed by Architect.

3.4 DECK REPAIR/REPLACEMENT

A. Repair existing deck to provide smooth working surface for installation of roof system.

1. Replace deck that cannot be repaired to sound condition.

B. Wood Roof Deck and Sheathing Replacement: Refer to Structural Drawings for repair details.

1. Install solid-sawn wood decking to match existing deck construction and to comply with applicable code.

2. Wood Sheathing Panels: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

3.5 EQUIPMENT REMOVAL AND REINSTALLATION

A. General: Remove, store, protect and reinstall rooftop equipment as required to accommodate roof tear-off and subsequent roofing work.

1. Raise roof curbs, equipment mountings and other roof penetration flashings as required to accommodate additional insulation thickness and maintain base flashing height of not less than 8 inches (200 mm), unless otherwise indicated.

a. Provide wood assemblies and additional support with miscellaneous galvanized steel angles, as required to rebuild or raise existing roof curbs.

b. Extend vent and soil stacks and other roof penetrations, using matching materials, as required to accommodate additional insulation thickness.

2. Extend existing ductwork inside existing roof curbs to accommodate extension of curb. By Mechanical Contractor.

a. Use materials matching existing ductwork; minimum of 20 ga. (0.9 mm) galvanized duct with Pittsburgh folded seam slip joints-typical.

B. Rooftop Equipment, Electrical: By Electrical Contractor.

1. Disconnect, reroute, extend and reconnect existing power feeders and control circuits (conduit and wiring) feeding the existing roof mounted equipment which is indicated to be raised and/or relocated to a new elevation/location and as required by the Contract.

2. Provide weatherproof exterior junction boxes, when required.

3. Make connections to mechanical equipment by using a maximum 18-inch (450 mm) length of liquid-tight flexible steel conduit.

    a. Rigid connections to mechanical equipment are not permitted.

4. Relocate and reconnect existing disconnect switches presently installed on existing roof mounted equipment indicated to be raised and/or relocated.

C. Prevent discharge of refrigerant. Verify that refrigerant has been properly recovered from equipment to be removed.

D. Reinstall designated equipment.

1. Make electrical reconnections in accordance with applicable code and authorities having jurisdiction. By Electrical Contractor.

2. Recharge HVAC equipment with refrigerant required by equipment manufacturer. By Mechanical Contractor.

3. Coordinate with Owner to test equipment and verify proper operation.

E. Remove and dispose of designated abandoned equipment. Infill openings in deck with matching materials. Infill roofing system with materials of same type as existing, adjacent roofing system.

3.6 TEMPORARY ROOFING MEMBRANE

A. Install approved temporary roofing membrane over area to be reroofed.

B. Remove temporary roofing membrane before installing new roofing membrane.

3.7 FASTENER PULL-OUT TESTING

A. Fastener Testing: Perform fastener pullout tests according to SPRI FX-1, and submit test report to Architect prior to installing new roofing system.

1. Obtain Architect’s and roofing manufacturer’s approval to proceed with specified fastening pattern.

2. Architect may furnish revised fastening pattern commensurate with pull-out test results.

B. Uplift Securement: Provide additional uplift securement for existing roofing system with new screws and plates applied to each roof zone at densities required to resist wind uplift pressures.

3.8 BASE FLASHING REMOVAL

A. Remove existing base flashings around parapets, curbs, walls, and penetrations.

1. Clean substrates of contaminants, such as asphalt, sheet materials, dirt, and debris.

B. Do not damage metal counterflashings that are to remain.

1. Replace metal counterflashings damaged during removal with counterflashings specified in Division 07 Section "Sheet Metal Flashing and Trim."

3.9 DISPOSAL

A. Collect demolished materials and place in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

1. Storage or sale of demolished items or materials on-site is not permitted.

B. Transport and legally dispose of demolished materials off Owner's property.

3.10 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by preparation for re-roofing operations. Return adjacent areas to condition existing before operations began.

END OF SECTION 07 01 50.19

SECTION 07 11 13 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cold-applied, cut-back-asphalt dampproofing.

B. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for bituminous vapor retarders under slabs-on-grade.
2. Section 04 20 00 "Unit Masonry" for mortar parge coat on masonry surfaces.
3. Section 07 14 16 "Cold Fluid-Applied Waterproofing" for waterproofing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 FIELD CONDITIONS

A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.

B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide protection course drainage panels and auxiliary materials recommended in writing by manufacturer of primary materials.

2.2 PERFORMANCE REQUIREMENTS

A. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise indicated.

2.3 COLD-APPLIED, CUT-BACK-ASPHALT DAMPPROOFING

A. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:

1. Henry Company; a Carlisle company.
2. Karnak Corporation.
3. W. R. Meadows, Inc.

B. Trowel Coats: ASTM D 4586/D 4586M, Type I, Class 1, fibered.

C. Brush and Spray Coats: ASTM D 4479/D 4479M, Type I, fibered.

2.4 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.

B. Cut-Back-Asphalt Primer: ASTM D 41/D 41M.

C. Asphalt-Coated Glass Fabric: ASTM D 1668/D 1668M, Type I.

D. Patching Compound: Epoxy or latex-modified repair mortar of type recommended in writing by dampproofing manufacturer.

E. Protection Course: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners.

1. Thickness: Nominal 1/8 inch(3 mm) .
2. Adhesive: Rubber-based solvent type recommended in writing by waterproofing manufacturer for protection course type.

F. Protection Course: Extruded-polystyrene board insulation, unfaced, ASTM C 578, Type X, 1/2 inch (13 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for surface smoothness, maximum surface moisture content, and other conditions affecting performance of the Work.

B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for dampproofing application.

B. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

C. Clean substrates of projections and substances detrimental to dampproofing work; fill voids, seal joints, and remove bond breakers if any.

D. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections ; cover with asphalt-coated glass fabric.

3.3 APPLICATION, GENERAL

A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless otherwise indicated.

1. Apply dampproofing to provide continuous plane of protection.
2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.

B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches (150 mm) over outside face of footing.

1. Extend dampproofing 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where indicated as "reinforced," by embedding an 8-inch- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

C. Where dampproofing exterior face of inner wythe of exterior masonry cavity walls, lap dampproofing at least 1/4 inch (6 mm) onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.

1. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe.
2. Lap dampproofing at least 1/4 inch (6 mm) onto shelf angles supporting veneer.

D. Where dampproofing interior face of above-grade, exterior concrete and masonry single-wythe masonry walls, continue dampproofing through intersecting walls by keeping vertical mortar joints at intersection temporarily open or by dampproofing wall before constructing intersecting walls.

3.4 COLD-APPLIED, CUT-BACK-ASPHALT DAMPPROOFING

A. Concrete Foundations and Parged Masonry Foundation Walls: Apply two brush or spray coats at not less than 1.25 gal./100 sq. ft.(0.5 L/sq. m) for first coat and 1 gal./100 sq. ft.(0.4 L/sq. m) for second coat .

B. Unparged Masonry Foundation Walls: Apply primer and two brush or spray coats at not less than 1.25 gal./100 sq. ft.(0.5 L/sq. m) for first coat and 1 gal./100 sq. ft.(0.4 L/sq. m) for second coat .

3.5 PROTECTION COURSE INSTALLATION

A. Install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.

1. Install protection course on same day of dampproofing installation (while coating is tacky) to ensure adhesion.

3.6 PROTECTION

A. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where panels are subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

B. Correct dampproofing that does not comply with requirements; repair substrates, and reapply dampproofing.

END OF SECTION 07 11 13

SECTION 07 14 16 - COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cold-applied waterproofing.
2. Protection course.
3. Insulation drainage panels.

B. Related Requirements:

1. Section 03 31 00 "Cast-in-Place Concrete" for moisture curing of concrete waterproofing substrate.
2. Section 04 20 00 "Unit Masonry" for compatibility with flashing components.
3. Section 07 92 00 "Joint Sealants" for joint sealants and accessories and joint preparation.
4. Section 09 30 00 "Tiling" for fluid-applied waterproof membranes beneath tiles.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1. Review waterproofing requirements including, but not limited to, the following:

a. Surface preparation specified in other Sections.
b. Minimum curing period.
c. Forecasted weather conditions.
d. Special details and sheet flashings.
e. Repairs.
f. Field quality control.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

B. Shop Drawings:

1. Show locations and extent of waterproofing.
2. Include details for each type of substrate, substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
3. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: Test data for waterproofing products and waterproofing system, by qualified testing agency, indicating proposed waterproofing meets performance requirements, when requested by Architect.

C. Warranty: Sample of unexecuted manufacturer and installer special warranties.

D. Field quality control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.

1. Build mockup for each typical waterproofing installation including accessories to demonstrate surface preparation, crack and joint treatments, inside and outside corner treatments, and protection.

a. Size: 100 sq. ft. (9.3 sq. m) in area .
b. Description: Each type of wall installation.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer.

1. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.
2. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.8 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace waterproofing that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Installer's Special Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.

1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pavers on plaza decks.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Waterproofing System: Obtain waterproofing materials , protection course, from single source from single manufacturer.

2.2 COLD-APPLIED SINGLE-COMPONENT WATERPROOFING

A. Single-Component Waterproofing: Water-based, polymer-modified rubberized asphalt complying with ASTM C836/C836M, with the following properties measured according to standard test methods referenced:

1. Products: Subject to compliance with requirements, provide Basis-of-Design Tremco, Inc., TREMproof 250GC, or an approved equal from the following:

a. Henry Company; a Carlisle company.
b. Karnak Corporation.
c. W. R. Meadows, Inc.

2. Hardness, ASTM D 2240: 70 – 80.
3. Low Temperature Flexibility and Crack Bridging, ASTM C 1305: Pass.
4. Adhesion in Peel, ASTM C 794: 26 lbf/in. (4553 N/m).

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials recommended in writing by waterproofing manufacturer for intended use and compatible with one another and with waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Substrate Patching Material: Waterproofing manufacturer's standard trowel-grade filler material.

C. Primer: Manufacturer's standard primer, sealer, or surface conditioner; factory-formulated.

D. Elastomeric Detail Sheet: Blended thermoset elastomeric sheet reinforced with polyester woven scrim.

1. Provide Tremco, TRA Elastomeric Sheeting or equal as recommended by manufacturer.

E. Metal Termination Bars: Waterproofing manufacturer's standard aluminum or stainless steel termination bar, with stainless steel fasteners.

F. Termination Mastic: Waterproofing manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade, with recommended glass-fiber-mesh tape.

G. Joint Sealant: Multicomponent non-sag polyurethane sealant, compatible with waterproofing, complying with ASTM C920, Type S, Grade NS, Class 50; and as recommended by manufacturer for substrate and joint conditions.

1. Backer Rod: Closed-cell polyethylene foam as recommended by manufacturer for substrate and joint conditions.

2.4 PROTECTION COURSE

A. Protection Course: Waterproofing manufacturer’s standard protection course material recommended for application.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Polyethylene (PE) sheet, 20 mil (0.51 mm) thick.

1) Provide Tremco, High Density Polyethylene Protection/Barrier Course or equal as recommended by manufacturer.

b. Woven glass-fiber fabric, synthetic resin-impregnated.
c. Extruded hollow-core copolymer mat.
d. UV-resistant lightweight polyester mat.

e. Elastomeric Sheet: Blended thermoset elastomeric sheet reinforced with polyester woven scrim.

2. Adhesive: Provide products as recommended in writing by waterproofing manufacturer.

2.5 DRAINAGE PANELS

A. Drainage Mat: Composite mat with drainage core, filter fabric, and protective polymeric film, recommended by waterproofing manufacturer for application.

1. Polystyrene core with nonwoven, needle-punched polypropylene fabric face and polymeric film backing; flow rate 18 gpm per foot (224 lpm per m) per ASTM D 4716.

a. Provide TREMDRAIN 1000 NW or equal as recommended by manufacturer.

2. Polystyrene core with woven polypropylene fabric face and polymeric film backing; flow rate 18 gpm per foot (224 lpm per m) per ASTM D 4716.

3. High compressive strength polystyrene core with nonwoven, needle-punched polypropylene fabric face and polymeric film backing; flow rate 9 gpm per foot (112 lpm per m) per ASTM D 4716.

4. Water-retaining perforated dimpled polystyrene core with spun-bonded polyolefin fabric on bottom face and copper hydroxide-treated non-woven, needle punched root barrier fabric on top face; flow rate 18 gpm per foot (224 lpm per m) at 1/2 inch (12 mm) thick per ASTM D 4716.

2.6 INSULATION DRAINAGE PANELS

A. Insulation: Comply with Section 07 21 00 "Thermal Insulation" for general building insulation , including insulation drainage panels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
2. Verify concrete is free from release agents, curing agents, laitance, and other contaminates.
3. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.

E. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, holes, and other voids.

F. Transitions to Adjacent Materials: Apply Manufacturer Approved Primer to transition cold fluid-applied waterpoofing membrane to adjacent components of the building envelope.

3.3 PREPARATION AT TERMINATIONS, PENETRATIONS, AND CORNERS

A. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, sleeves, and corners according to waterproofing manufacturer's written instructions and to recommendations in ASTM C1471/C1471M.

B. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrate according to waterproofing manufacturer's written instructions and to recommendations in ASTM C1471/C1471M. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D4258.

1. Comply with ASTM C1193 for joint-sealant installation.
2. Apply bond breaker on sealant surface, beneath preparation strip.
3. Prime substrate along each side of joint and apply a single thickness of preparation strip at least 6 inches (150 mm) wide along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.

3.5 INSTALLATION OF WATERPROOFING

A. Apply waterproofing according to manufacturer's written instructions and to recommendations in ASTM C1471/C1471M.

B. Start installing waterproofing in presence of manufacturer's technical representative.

C. Apply primer over prepared substrate unless otherwise instructed in writing by waterproofing manufacturer.

D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.

1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases and pinholes, with a dry film thickness of 60 mils (1.5 mm) .
2. Apply waterproofing to prepared wall terminations and vertical surfaces.
3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft. (9.3 sq. m).

E. Reinforced Waterproofing Applications: Mix materials and apply waterproofing by roller, notched squeegee, trowel, or other suitable application method.

1. Apply first coat of waterproofing, embed membrane-reinforcing fabric, and apply second coat of waterproofing to completely saturate reinforcing fabric and to obtain a seamless reinforced membrane free of entrapped gases and pinholes, with an average dry film total thickness of 70 mils (1.8 mm) .
2. Apply reinforced waterproofing to prepared wall terminations and vertical surfaces.
3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft. (9.3 sq. m).

F. Cure waterproofing, taking care to prevent contamination and damage during application and curing.

G. Install protection course with butted joints over waterproofing before starting subsequent construction operations.

1. For horizontal applications, install protection course loose laid over fully cured membrane.

2. For vertical applications, set protection course in nominally cured membrane, which will act as an adhesive. If membrane cures before application of protection course, use adhesive.
3. Insulation drainage panels Thermal insulation specified in Section 07 21 00 "Thermal Insulation" may be used in place of a separate protection course for vertical applications when approved in writing by waterproofing manufacturer.

3.6 INSTALLATION OF INSULATION DRAINAGE PANELS

A. Install drainage panels over waterproofed surfaces. Cut and fit to within 1/2 inch (12 mm) of projections and penetrations.

B. Ensure that drainage channels are aligned and free of obstructions.

C. On vertical surfaces, set insulation drainage panels in adhesive or tape applied according to manufacturer's written instructions.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections:

1. Testing agency shall verify thickness of waterproofing during application for each 600 sq. ft. (56 sq. m) of installed waterproofing or part thereof.

B. Manufacturer's Field Service: Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components and to furnish daily reports to Architect.

C. Waterproofing will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.8 PROTECTION

A. Clean spills, stains, and overspray resulting from application utilizing cleaning agents recommended by manufacturers of affected construction. Remove masking materials.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

END OF SECTION 07 14 16

SECTION 07 18 00 – TRAFFIC COATINGS, PEDESTRIAN TRAFFIC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Polyurethane methacrylate and polymethyl methacrylate technology traffic coatings for pedestrian traffic applications

B. Related Requirements:

1. Section 03 31 00 "Cast-in-Place Concrete" for moisture curing of concrete traffic coating substrate.
2. Section 07 92 00 "Joint Sealants" for joint sealants and accessories and joint preparation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1. Review requirements for traffic coating products and installation, including surface preparation, substrate conditions, expansion joints as required, project and manufacturer's details, installation procedures, mockups, testing and inspection requirements, protection and repairs, and coordination and sequencing of traffic coating work with work of other Sections.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of traffic coating product and expansion joint accessory specified, indicating compliance with requirements.

B. Shop Drawings:

1. Show locations for traffic coating system components.
2. Show details for each type of substrate, movement joints, corners, and edge conditions, including penetrations, transitions, and terminations.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Certification of manufacturer's approval of Installer.

1. Applicator shall submit documentation from the membrane manufacturer to verify contractor’s status as a qualified approved applicator for warranted installations.

B. Product Test Reports: Test data for traffic coating products and traffic coating system, by qualified testing agency, indicating proposed traffic coating meets performance requirements, when requested by Architect.

C. Warranty: Sample of unexecuted manufacturer and installer special warranties.

D. Field quality control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A manufacturer-approved firm with minimum five years' experience in installation of specified or similar products in successful use on similar projects, employing workers trained by manufacturer, including a full-time on-site supervisor with a minimum of three years' experience installing similar work, and able to communicate verbally with Contractor and employees.

B. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.

1. Provide traffic coating mockup application within mockups required in other sections, or if not specified, in an area of not less than 150 sq. ft. (14 sq. m) of surface where directed by Architect for each type of substrate condition. Include examples of surface preparation, crack and joint treatment, traffic coating application, slip-resistant aggregate application, and flashing, transition, and termination conditions, to set quality standards for execution.

a. Include intersections of deck traffic coating with adjacent vertical coating and moisture control system applications.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Apply traffic coating within the range of ambient and substrate temperatures recommended by traffic coating manufacturer.

1. Protect substrates from environmental conditions that affect system performance.
2. Do not apply traffic coating)or expansion joint accessories if applicable) to a damp or wet substrate or during snow, rain, fog, or mist.

B. Maintain adequate ventilation during application and curing of traffic coating materials.

1.8 SCHEDULING

A. Coordinate installation of traffic coating with completion of roofing and other work requiring interface with traffic coating.

B. Schedule work so traffic coating system (including expansion joints if applicable) applications may be inspected prior to concealment.

1.9 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer's standard form in which traffic coating manufacturer agrees to furnish traffic coating material to repair or replace those materials installed according to manufacturer's written instructions that exhibit material defects or otherwise fail to perform as specified under normal use within warranty period specified.

1. Warranty Period: Twenty years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Provide traffic coating system materials and accessory products from single-source manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Traffic coating system shall be capable of performing as a continuous watertight installation and as a moisture drainage plane transitioned to adjacent flashings and discharging water to the structure exterior. Traffic coating shall accommodate normal substrate movement and seal expansion and control joints, construction material transitions, opening transitions, penetrations, and perimeter conditions without resultant moisture deterioration.

B. Compatibility: Provide traffic coating system materials that are compatible with one another and with adjacent materials under conditions of service and application required, as demonstrated by traffic coating manufacturer based on testing and field experience.

2.3 TRAFFIC COATING FOR PEDESTRIAN TRAFFIC, EXTREME WEAR SYSTEM (EWS)

A. Traffic Coating: Manufacturer's polyurethane methyl methacrylate system for extreme exterior exposure conditions, traffic-bearing, seamless, high-solids-content, cold liquid-applied, elastomeric, waterproofing membrane system with integral wearing surface for pedestrian traffic.

1. Products: Subject to compliance with requirements, provide the following or equal:

a. Tremco, Inc., Vulkem 350FC/951NF

B. Primer: Two-component, chemically curing methyl methacrylate

C. Base Coats: Polyurethane methacrylate

D. Top Coat: Methyl Methacrylate

1. Color: As selected by Architect from manufacturer's full range.

E. Aggregate: Manufacturer's standard aggregate for each use indicated of particle sizes, shape, and minimum hardness recommended in writing by traffic-coating manufacturer.

F. Flashing: Manufacturer’s flexible reinforcing flashing, transition compatible with traffic coating and cavity wall system.

1. Products: Subject to compliance with requirements, provide the following or equal:

a. Tremco, Inc., DualFlex DS

2.4 AUXILIARY MATERIALS

A. Aggregate: Manufacturer's standard aggregate for each use indicated of particle sizes, shape, and minimum hardness recommended in writing by traffic-coating manufacturer.

B. Manufacturer’s recommended Initiator; Benzoyl Peroxide

C. Manufacturer’s recommended Cleaner; One component methyl methacrylate

D. Manufacturer’s recommended Crack and Joint Detailing Coating

E. Manufacturer’s recommended Vertical and Ramp Application Coating

F. Expansion Joint Pre-compressed or Closed Cell, Monolithic Foam System as recommended by manufacturer for substrate and joint conditions. Foam Structure Must not Contain Unbonded Foam Laminations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Surface Condition: Before applying traffic coating materials and system accessories, examine substrate and conditions to ensure substrates are fully cured, smooth, and free from high spots, depressions, loose and foreign particles and other deterrents to adhesion, and conditions comply with manufacturer's written recommendations.

1. Verify concrete surfaces are visibly dry, have cured for time period recommended by traffic coating manufacturer, and are free from release agents, curing agents, laitance, and other contaminates.
2. Test surfaces following cleaning and abrasion specified below.

a. Test for capillary moisture by method recommended in writing by traffic-coating manufacturer.
b. Test for traffic coating adhesion per manufacturer's recommended method.
c. Notify Architect in writing of unsatisfactory conditions.

B. Proceed with installation once unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean, prepare, and treat substrates in accordance with ASTM C1127 and traffic coating manufacturer's written instructions.

1. Remove contaminants, curing compounds, and film-forming coatings from substrates.
2. Remove projections and excess materials and fill voids with manufacturer's recommended substrate patching material.
3. Mechanically abrade concrete surfaces by method of shot blasting to a uniform profile in accordance with ASTM D4259 and meeting ICRI Surface Profile CSP 3. Do not acid etch.
4. Clean prepared surfaces in accordance with ASTM D4258.

B. Protect adjacent finished surfaces by masking. Mask termination point on vertical surfaces. Protect weep holes and drains.

C. For accessory materials, follow manufacturers application instructions.

3.3 TERMINATIONS AND PENETRATIONS

A. Prepare vertical and horizontal surfaces at horizontal to vertical transitions, terminations, joints, and penetrations through traffic coatings in accordance with ASTM C1127 and manufacturer's written instructions, using accessory materials specified.

B. At terminations of traffic coating exposed to traffic, rout 1/4 by 1/4 inch keyway in concrete.

C. Detail Preparation: Prepare non-moving shrinkage cracks, large cracks, construction joints, expansion joints, projections and protrusions, penetrations, drains, and changes in plane in accordance with manufacturer's written instructions and details.
1. Prepare joints and cracks in substrate in accordance with ASTM C1127 and ASTM D4258 and manufacturer's written instructions.

D. Joint Coating Installation: Comply with manufacturer's written instructions. Allow joint coatings to cure adequately before coating with traffic coating.

1. Provide coating cants at penetrations and at horizontal-to-vertical intersections. Tool coating material to form 45 degree angle transition. Penetrations must be grouted solid at all instances.
2. Rout and fill cracks with coating and tool flush with surface.
3. Feather edges of joint coating applications.
4. Allow coating to cure.
5. Fill expansion joints less than 1” with backer rod and joint sealant contact manufacturer for sealant recommendation. Do not apply traffic coating over expansion joints.

6. Fill expansion joints greater than 1” with specified Expansion Joint material, contact manufacturer for sealant recommendation. Do not apply traffic coating over expansion joints.

3.4 PEDESTRIAN TRAFFIC-COATING APPLICATION

A. Primer: Prime surfaces to receive traffic coating system. Allow to cure before proceeding.

B. Start traffic-coating application in presence of manufacturer's technical representative.

C. Apply traffic coating according to manufacturer's written instructions.

1. Verify that wet film thickness of each coat complies with requirements every 100 sq. ft. (9 sq. m).

D. Apply number of coats of specified compositions for pedestrian coating at locations indicated on Drawings, per manufactures written installation instructions

E. Apply traffic coatings to prepared wall terminations and vertical surfaces to height indicated; omit aggregate on vertical surfaces.

F. Cure traffic coatings. Prevent contamination and damage during application and curing stages.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, traffic coating application, protection, and drainage components, and to furnish reports to Architect.

B. Coordination of Testing: Cooperate with testing agency. Allow access to work areas and staging. Notify testing agency in writing of schedule for Work of this Section to allow sufficient time for testing and inspection.

1. Do not cover Work until testing and inspection is completed and accepted.

C. Reporting: Forward written inspection reports to the Architect within 3 working days of the inspection and test being performed.

D. Correction: Correct deficient applications not passing tests and inspections, make necessary repairs, and retest as required to demonstrate compliance with requirements.

3.6 PROTECTION

A. Clean spills, stains, and overspray resulting from application utilizing cleaning agents recommended by manufacturers of affected construction. Remove masking materials.

B. Protect traffic coating from damage and wear during remainder of construction period.

C. Protect layers in the traffic coating system that are not UV stable from exposure to UV light for period in excess of that acceptable to traffic coating manufacturer; replace overexposed materials and retest.

END OF SECTION 07 18 00

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board insulation.
2. Glass-fiber blanket insulation.
3. Mineral-wool blanket insulation.
4. Loose-fill insulation.

B. Related Requirements:

1. Section 04 20 00 "Unit Masonry" for insulation installed in masonry cells.
2. Section 06 16 00 "Sheathing" for foam-plastic board sheathing installed directly over wood or steel framing.
3. Section 07 54 16 “Ketone Ethylene Ester (KEE) Roofing” for insulation specified as part of KEE roof construction.
4. Section 09 29 00 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Extruded polystyrene foam-plastic board insulation.
2. Glass-fiber blanket insulation.
3. Mineral-wool blanket insulation.
4. Loose-fill insulation.

1.4 INFORMATIONAL SUBMITTALS

A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Research Reports: For foam-plastic insulation, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

A. Extruded Polystyrene Board Insulation, Type IV: ASTM C578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. DiversiFoam Products.
b. DuPont de Nemours, Inc.
c. Kingspan Insulation LLC.
d. Owens Corning.
e. The Dow Chemical Company.
f. Insulfoam

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
4. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
5. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

B. Extruded Polystyrene Board Insulation, Type IV, Drainage Panels: ASTM C578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. DiversiFoam Products.
b. DuPont de Nemours, Inc.
c. Owens Corning.
d. The Dow Chemical Company.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

2.2 GLASS-FIBER BLANKET INSULATION

A. Glass-Fiber Blanket Insulation, Unfaced: ASTM C665, Type I; passing ASTM E136 for combustion characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed; SAINT-GOBAIN.
b. Johns Manville; a Berkshire Hathaway company.
c. Knauf Insulation.
d. Owens Corning.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

B. Glass-Fiber Blanket Insulation, Kraft Faced: ASTM C665, Type II (nonreflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed; SAINT-GOBAIN.
b. Johns Manville; a Berkshire Hathaway company.
c. Knauf Insulation.
d. Owens Corning.

2. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

C. Glass-Fiber Blanket Insulation, Reinforced-Foil Face: ASTM C665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed; SAINT-GOBAIN.
b. Johns Manville; a Berkshire Hathaway company.
c. Knauf Insulation.
d. Owens Corning.

2. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

D. Glass-Fiber Blanket Insulation, Foil Faced: ASTM C665, Type III (reflective faced), Class B (faced surface with a flame-propagation resistance of 0.12 W/sq. cm); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed; SAINT-GOBAIN.
b. Johns Manville; a Berkshire Hathaway company.
c. Knauf Insulation.
d. Owens Corning.

2. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

2.3 MINERAL-WOOL BLANKET INSULATION

A. Mineral-Wool Blanket Insulation, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Johns Manville; a Berkshire Hathaway company.
b. Owens Corning.
c. ROCKWOOL.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

B. Mineral-Wool Blanket Insulation, Reinforced-Foil Faced: ASTM C665, Type III (reflective faced); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Owens Corning.
2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.

4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

2.4 LOOSE-FILL INSULATION

A. Cellulosic-Fiber Loose-Fill Insulation: ASTM C739, chemically treated for flame-resistance, processing, and handling characteristics.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Greenfiber, LLC.
   b. Hamilton Manufacturing, Inc. (HMI).
   c. Nu-Wool Co., Inc.

2.5 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. AGM Industries, Inc.
      b. Gemco.

   2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
   3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.

B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. AGM Industries, Inc.
      b. Gemco.

   2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:

      a. Crawl spaces.
      b. Ceiling plenums.
      c. Attic spaces.

C. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of 2 inches (50 mm) between face of insulation and substrate to which anchor is attached.

   1. Manufacturers: Subject to compliance with requirements, provide products by the following:

      a. Gemco.

D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. AGM Industries, Inc.

b. Gemco.

2.6 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.

B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

C. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) in from exterior walls.

3.4 INSTALLATION OF FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions.
2. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.
3. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
4. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
5. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.5 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer.

1. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
2. Press units firmly against inside substrates.
3. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 04 20 00 "Unit Masonry."

B. Cellular-Glass Board Insulation: Install with closely fitting joints using attachment method according to manufacturer's written instructions.

C. Mineral-Wool Board Insulation: Install insulation fasteners 4 inches (100 mm) from each corner of board insulation, at center of board, and as recommended by manufacturer.

1. Fit courses of insulation between masonry wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
2. Press units firmly against inside substrates.

3.6 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

6. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.

   a. Exterior Walls: Set units with facing placed toward as indicated on Drawings.
   b. Interior Walls: Set units with facing placed toward areas of high humidity .

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

C. Loose-Fill Insulation: Apply according to ASTM C1015 and manufacturer's written instructions.

1. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not compact excessively.
2. For cellulosic-fiber loose-fill insulation, comply with CIMA's Bulletin #2, "Standard Practice for Installing Cellulose Insulation."

3.7 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

SECTION 07 21 29 – SPRAY ACOUSTICAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sprayed cellulose acoustical insulation

B. Related Requirements:

1. Section 07 81 00 "Applied Fire Protection" for fire-resistive materials applied prior to acoustic spray. Materials must be compatible and maintain fire rating

C. Related Requirements:

1. Clips, hangers, supports, sleeves and other attachments to spray bases are to be placed by other trades prior to the application of sprayed insulation.
2. Ducts, piping, conduit or other suspended equipment shall not be positioned until after the application of sprayed insulation.
3. Roof penetrations to be installed prior to application.

1.3 ACTION SUBMITTALS

1. Product Data: For each type of product.

   a. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products

2. Shop Drawings: Framing plans or schedules, or both, indicating the following:

   a. Extent of acoustic spray insulation for each construction and fire-resistance rating.
   b. Minimum acoustic sprayed material thicknesses needed to achieve required NRC rating.

3. Samples: For each exposed product and for each color and texture specified, 4 inches (102 mm) square in size.

1.4 INFORMATIONAL SUBMITTALS

A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Research Reports: For foam-plastic insulation, from ICC-ES.

1.5 QUALTIY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects to set quality standards for materials and execution and for preconstruction testing.

1. Build mockup of each type of product and different substrate and each required finish as shown on Drawings.

a. Size: 100 square ft in area

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 PRECONSTRUCTION TESTING

A. Material must be tested in accordance with ASTM E 1042 by a NVLAP accredited testing laboratory.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Acoustical Spray-On System

1. Products: Subject to compliance with requirements, provide one of the following or approved equal:

a. International Cellulose Corporation, K-13 Spray-On Systems

2. Bond strength shall be greater than 150 psf per ASTM E 736.
3. Product shall be Class 1 Class A per ASTM E 84/ UL 723.
4. Non-corrosive per ASTM C 1149
5. Bond Deflection per ASTM E 759: 6” Deflection in 10’ Span – No Spalling or Delamination.
6. R-Value to be 3.70 per inch per ASTM C 518.
7. Meet ASTM C 1149
8. Manufacturer's written certification that product contains no asbestos, fiberglass or other man-made mineral fibers.
9. Cannot contain any added Urea-Formaldehyde Resins.
10. Color shall be from Manufacturer’s standard color chart or custom color as noted
11. Each bag must be labeled with appropriate UL classification and FM markings
12. Each drum of adhesive must be labeled “SK-2000 adhesive to be used with K-13”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and report unsatisfactory conditions in writing. Do not proceed until unsatisfactory conditions are corrected.

B. Verify surfaces to receive spray insulation to determine if priming/sealing is required to insure bonding and/or to prevent discoloration caused by migratory stains.

3.2 PREPARATION

A. Provide masking, drop cloths or other satisfactory coverings for materials/surfaces that are not to receive

insulation to protect from over-spray.

B. Coordinate installation of the sprayed cellulose fiber with work of other trades.

C. Prime surfaces as required by manufacturer's instructions or as determined by examination.

D. Prime all gypsum board surfaces with high quality, commercial, gypsum board primer

3.3 INSTALLATION

A. Comply with manufacturer's written instructions applicable to products and applications.

B. Install spray applied insulation to achieve an average NRC of 1.0. Refer to manufacturer's written instructions for required thickness necessary to achieve this value.

C. Cure insulation with continuous natural or mechanical ventilation.

1. Continuous ventilation must be maintained until the material has properly cured.

D. Remove and dispose of over-spray.

3.4 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 29

SECTION 07 27 26 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes fluid-applied, vapor-retarding membrane air barriers.

1. For use as an air barrier on exterior walls.

B. Related Requirements:

1. Section 04 20 00 “Unit Masonry”.
2. Section 09 29 00 "Gypsum Board" for wall sheathings and wall sheathing joint-and-penetration treatments.
3. Section 07 21 00 “Thermal Insulation”.
4. Section 07 62 00 “Sheet Metal Flashing and Trim” for Through-Wall Flashings.

1.3 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products approved per NFPA 285.

B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
2. Include details of interfaces with other materials that form part of air barrier.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by the Installer, who work on Project.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

D. Field quality-control reports.

1.7 PERFORMANCE REQUIREMENTS

A. Installed product and accessories constitute a continuous air barrier, as described in ASHRAE Standard 90.1-2010 Section 5.4.3.1

B. Installed product and accessories shall perform as a liquid water drainage plane flashed to discharge to the exterior and incidental condensation or water penetration.

C. Exterior wall assemblies incorporating the product and accessories shall be tested in accordance with and comply with the acceptance criteria od NFPA 285.

D. Product shall be a nominal 0.040 inch (40 mils) thickness membrane, with dry film thickness of installed product measuring a minimum of 0.030 inch (30 mils) with a comb gauge.

E. Product shall meet the following requirements:

REQUIREMENT	RESULT	TEST METHOD
Air Permeance – on Porous Substrate	Not more than 0.02 L/s*m^2 at 75 Pa (0.004 CFM/ft^2 at 1.57 PSF)	ASTM E-2178, mod sprayed on CMU
Air Permeance – Free Film	Not more than 0.02 L/s*m^2 at 75 Pa (0.004 CFM/ft^2 at 1.57 PSF)	ASTM E-2178
Low Temperature Flexibility	No cracking at minus 20 degrees F, 180 degree bend over 1 inch mandrel	ASTM D 1970
Low-Temperature Crack Bridging	No cracking after 10 cycles at minus 15 deg F	ASTM C 1305, mod 40 mil membrane thickness
Long-Term Aging/ Flexibility	No cracking or tearing after aging	ASTM C 1522, mod 40 mil membrane thickness OR CGSB 71-GP-24M
Fastener Sealability	No water leaking through nail penetration after 24 h.	ASTM D 1970
Water Resistance	Product spray-applied to CMU and gypsum sheathing with joint shall resist a 55 cm (22 inch) column of water for 5 hours, no leaking or wet through.	AATCC-127 - mod, static head generated with 5”diameter PVC pipe sealed to specimen
Pull Adhesion	Not less than 16 lb_f per square inch (or report value at substrate failure) on glass-faced gypsum sheathing and concrete masonry unit (CMU)	ASTM D 4541, modified 4 inch wood puck
Water Vapor Permeance – Vapor Barrier Type Only	Not more than 1 Perm	ASTM E-96, Method B
Water Vapor Permeance – Vapor Permeable Type Only	Not less than 10 Perms	ASTM E-96, Method B
Surface Burning Characteristics.	Flame Spread Index: Not more than 25 Smoke Generation Index: Not more than 450	ASTM E 84, sample tested at full coverage, 40 mil dry film, cement board substrate

Measurement of Heat Release Rate by Cone Calorimeter	Average Effective Heat of Combustion: Not more than 12.3 MJ/kg [5,300 BTU/lb] Total Heat Released per Area: not more than 14.7 MJ/m^2 [1,296 BTU/ft^2]	ASTM E 1354, membrane applied to glass-faced gypsum sheathing

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to set quality standards for materials and execution and for preconstruction testing.

1. Build integrated mockups of exterior wall assembly, 16 sq. ft. (14 sq. m), incorporating backup wall construction, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.

a. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PRECONSTRUCTION TESTING

A. Mockup Testing: Air-barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.

1. Quantitative Air-Leakage Testing: Mockups will be tested for air leakage according to ASTM E 783.
2. Adhesion Testing: Mockups will be tested for minimum air-barrier adhesion of 30 lbf/sq. in. (207 kPa) according to ASTM D 4541.
3. Notify Architect seven days in advance of the dates and times when mockups will be tested.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product, lot number and directions for storage.

B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by manufacturer.

C. Avoid spillage. Immediately notify Architect if spillage occurs and start clean up procedures. Clean spills and leave area as it was prior to spill.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1.12 WARRANTY

A. Provide the manufacturer’s minimum five year material warranty.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

B. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and complying with VOC content limits of authorities having jurisdiction.

C. Low-Emitting Materials: Air barriers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 2357.

2.3 VAPOR-RETARDING MEMBRANE AIR BARRIER

A. Fluid-Applied, Vapor-Retarding Membrane Air Barrier: Elastomeric, modified bituminous membrane.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Elastomeric, Modified Bituminous Membrane:

1) Carlisle Coatings & Waterproofing Inc.; Barritech NP.
2) Henry Company; Air-Bloc 21S.
3) Meadows, W. R., Inc.; Air-Shield LM.
4) Tremco Incorporated, an RPM company; ExoAir 120SP.
5) StoGuard VaporSeal
6) Prosoco R-guard.

2. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E 2178.
b. Water Vapor Permeance: Maximum 1 perm , ASTM E 96, Method B.
c. Ultimate Elongation: Minimum 500 percent; ASTM D 412, Die C.
d. Adhesion to Substrate : Minimum 30lbf/sq in. when tested according to ASTM D 4541.

2.4 ACCESSORY MATERIALS

A. General: Accessory materials shall be from same manufacturer or as recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.

B. Detail Flashing: Foil-faced butyl or foil-faced rubberized asphalt flashing, minimum 0.030” (30 mils) thickness. Approved with air barrier membrane in NFPA 285 wall assemblies.

1. Carlisle Coatings & Waterproofing, Incorporated: Fire-Resist 705 FR-A or AlumaGRIP-701.
2. Others as approved by air barrier membrane manufacturer.

C. Contact Adhesive:

1. Carlisle Coatings & Waterproofing, Incorporated: CCW-702 Solvent-Based, CCW-702 LV VOC Compliant Solvent-Based, CCW-702 WB Water-Based, CAV-GRIP™ Aerosol Spray or Travel-Tack portable aerosol spray cans.
2. Products by others as approved by Architect.

D. Detail Mastic:

1. SURE-SEAL Lap Sealant by Carlisle Coatings & Waterproofing, Incorporated.
2. Products by others as approved by Architect.

E. Transition Membrane:

1. CCW SURE-SEAL Pressure-Sensitive Elastoform by Carlisle Coatings & Waterproofing, Incorporated.
2. Products by others as approved by Architect.

F. Transition Membrane Primer:

1. Carlisle Coatings & Waterproofing, Incorporated: SURE-SEAL HP-250 Primer, SURE-SEAL EP-95 Splicing Cement or SURE-SEAL Low VOC EPDM Primer.
2. Products by others as approved by Architect.

G. Reinforcing Fabric: Woven, synthetic polymer fabric.

1. DCH Reinforcing Fabric by Carlisle Coatings & Waterproofing, Incorporated.
2. Products by others as approved by Architect.

H. Glass Mat: Randomly-oriented glass strands held in binder soluble in wet air barrier membrane. Offered in rolls of various widths.

1. LiquiFiber-W
2. Products by others as approved by Architect.

I. Fill Compound: 2-part, non-sag polyurethane sealant.

1. Carlisle Coatings & Waterproofing, Incorporated: CCW-703 V or CCW-201.
2. Products by others as approved by Architect.

2.5 RELATED MATERIALS

A. Paintable Sealant, select any:

1. Sikaflex-1A 1-part polyurethane sealant
2. Sonneborn NP-1 1-part polyurethane sealant
3. ChemLink Novalink 1-part polyether sealant
4. Pecora AC-20 outdoor grade, acrylic latex sealant
5. DAP ALEX PLUS outdoor grade, acrylic latex sealant
6. Other product approved by air barrier membrane manufacturer

B. Silicone Sealant, select any:

1. Dow 790, 791, 795
2. Pecora 890, 891, 895
3. GE Silpruf, Silpruf LM
4. Other product approved by air barrier membrane manufacturer

C. Polyurethane Foam Sealant, select any:

1. Great Stuff by Dow Chemical Company
2. Froth Pack by Dow Chemical Company
3. Other product approved by air barrier membrane manufacturer

D. Insulation Adhesive, select any:

1. Sonneborn Premium Adhesive
2. QB-300 Multi-Pupose Construction Adhesive by OSI
3. PL-300 VOC Foamboard Adhesive by Loctite
4. Other product approved by air barrier membrane and board foam insulation manufacturer

PART 3- EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that masonry joints are flush and completely filled with mortar.
3. Sheathing boards shall be flush at joints, with gaps between boards according to building code and sheathing manufacturer's requirements. Sheathing boards shall also be securely fastened to the structure with proper fastener type, technique and spacing according to building code and sheathing manufacturer's requirements. Sheathing boards shall be repaired or replaced if inspection reveals moisture damage, mechanical damage or if sheathing boards have exceeded the exposure duration or exposure conditions as required by the sheathing manufacturer.

B. Proceed with installation only after unsatisfactory conditions have been corrected, notified architect of the following conditions:

1. Cracks in concrete and masonry.
2. Gaps or obstructions such as steel beams, angles, plates and projections which cannot be spanned or covered by Product or Accessories.
3. Anticipated problems applying product and accessories over substrate.

3.2 SURFACE PREPARATION

A. Fluid-applied Membrane Air Barrier material applied to the cavity side of the CMU. Special attention and care must be taken to provide a smooth, filled surface to receive the membrane. Concrete masonry unit (CMU) wall shall be prepared as follows to accept the air & vapor barrier:

1. Surfaces shall be free of contaminants such as grease, oil and wax on surfaces to receive membrane
2. The CMU surfaces shall be free from projections.
3. Strike all mortar joints flush to the face of the concrete block.
4. Fill all voids and holes greater than ¼ inch across at any point with mortar, sealant or other approved fill material.
5. Surface irregularities exceeding ¼ inch in height or sharp to touch shall be ground flush or made smooth.
6. Fill around all penetrations with mortar, sealant or other approved fill material and strike flush.
7. If the surfaces cannot be made smooth to the satisfaction of the Architect, it will be the responsibility of the trade to alternatively apply a parge coat (one part cement to three parts sand) over the entire surface to receive Air & Vapor Barrier Membrane
8. Remove mortar droppings on brick ties, shelf angles, brick shelves or other horizontal obstructions.

B. Fill cracks, gaps and joints exceeding ¼ inch width with fill compound or paintable sealant.

C. Fill rough gaps around pipe, conduit and similar penetrations with mortar, non-shrink grout, fill compound or polyurethane foam sealant shaved flush.

D. Apply a ¾ inch cant of fill compound at the intersection of the base of the wall and the footing.

3.3 DETAILING

A. Additional materials and installation are required at joints, transitions, openings, terminations, penetrations and similar surface irregularities. Perform detailing before or after product installation.

B. Install product and accessories in details as directed in manufacturer's literature.

C. Sheathing joints, use any of the following methods:

1. 4 inch reinforcing fabric imbedded in product and centered over joint.
2. Paintable sealant or fill compound, tooled as shown in details.

D. Sheathing inside and outside corners. Flashing or reinforcement shall bear 3 inches minimum onto either side of angle change. Use any of the following methods:

1. Minimum 9 inch detail flashing centered over angle change
2. 12 inch reinforcing fabric centered over angle change and imbedded in product
3. 12 inch glass mat centered over angle change and imbedded in product

E. TR Pipe or duct penetrations. Flashing or reinforcement shall bear onto wall 3 inches minimum and shall bear onto pipe or duct 3 inches, or according to Project drawings. Select any:

1. Detail flashing
2. Glass mat imbedded in product

F. Expansion or deflection joints. Flashing shall bear 3 inches minimum onto either side of joint. Select any:

1. Detail flashing bellows or expansion bulb
2. Transition membrane expansion bulb

G. Interface of dissimilar substrates: Flashing or reinforcement shall bear 3 inches minimum onto either side of joint. Select any:

1. Minimum 9 inch detail flashing
2. 12 inch reinforcing fabric imbedded in product
3. 12 inch glass mat imbedded in product

3.4 FLUID AIR-BARRIER MEMBRANE INSTALLATION

A. General: Spray apply fluid air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions. Apply fluid air-barrier material within manufacturer's recommended application temperature range Retain first subparagraph below if priming of substrates is required; verify requirements with manufacturer.

1. Apply primer to substrates at required rate and allow it to dry.
2. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.

B. Membrane Air Barriers: Apply a continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier membrane in full contact around protrusions such as masonry ties.

1. Vapor-Retarding Membrane Air Barrier: Total dry film thickness as recommended in writing by manufacturer to meet performance requirements, but not less than 40-mil (1.0-mm) dry film thickness, applied in one or more equal coats.

C. Apply strip and transition strip a minimum of 1 inch (25 mm) onto cured air-barrier material or strip and transition strip over cured air-barrier material overlapping 3 inches (75 mm) onto each surface according to air-barrier manufacturer's written instructions.

D. Do not cover air barrier until it has been tested and inspected by testing agency.

E. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.5 FIELD QUALITY CONTROL

A. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air-barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed, if applicable.
7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Strips and transition strips have been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

B. Tests: As determined by testing agency from among the following tests:

1. Quantitative Air-Leakage Testing: Air-barrier assemblies will be tested for air leakage according to ASTM E 783.
2. Adhesion Testing: Air-barrier assemblies will be tested for minimum air-barrier adhesion of 30 lbf/sq. in. (207 kPa) according to ASTM D 4541 for each 600 sq. ft. (56 sq. m) of installed air barrier or part thereof.
3. Provide copies of tests to Architects.

C. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

D. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.6 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than 30 days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 07 27 26

SECTION 07 31 13 – ASPHLAT SHINGLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Asphalt shingles.
2. Underlayment.
3. Leak Barrier.

B. Related Sections:

1. Section 06 10 53 "Miscellaneous Rough Carpentry" for wood framing.
2. Section 06 16 00 "Sheathing" for roof sheathing.
3. Section 07 62 00 "Sheet Metal Flashing and Trim" for metal counterflashings, and flashings.

1.3 DEFINITION

A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For the following products, of sizes indicated, to verify color selected:

1. Asphalt Shingle: Full size.
2. Ridge and Hip Cap Shingles: Full size.
3. Exposed Valley Lining: 12 inches (300 mm) square.
4. Self-Adhering Leak Barrier : 12 inches (300 mm) square.
5. Deck Protection Underlayment: 10 inches square.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for asphalt shingles.

C. Research/Evaluation Reports: For each type of asphalt shingle required, from the ICC.

D. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of asphalt shingle to include in maintenance manuals.

1.7 MATERIALS MAINTENANCE SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Asphalt Shingles: 50 sq.ft. of each type, in unbroken bundles.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Fire-Resistance Characteristics: Where indicated, provide asphalt shingles and related roofing materials identical to those of assemblies tested for fire resistance per test method below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

1. Exterior Fire-Test Exposure: Class A ASTM E 108 or UL 790, for application and roof slopes indicated.

C. Preinstallation Conference: Conduct conference at Project site.

D. A single source manufacturer is required for roofing system per warranty requirements.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store roofing materials in a dry, well-ventilated, weathertight location according to asphalt shingle manufacturer's written instructions. Store underlayment rolls on end on pallets or other raised surfaces. Do not double stack rolls.

1. Handle, store, and place roofing materials in a manner to avoid significant or permanent damage to roof deck or structural supporting members.

B. Protect unused underlayment from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install asphalt shingles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1. Install self-adhering sheet underlayment within the range of ambient and substrate temperatures recommended by manufacturer.

1.11 WARRANTY

A Provide to the Client Agency a GAF® WeatherStopper® Silver Pledge Ltd Warranty covering, or approved equal by alternate manufacturer:

1. Roofs installed by a Certified GAF® Master Elite™ Contractor only, or another certified installer by an alternative approved manufacturer.

2. Manufacturing defects: 100% coverage for materials and labor for:

a. 40 years with the first 20 years non - prorated. (excludes Marquis WeatherMax and Royal Sovereign)

3. Workmanship errors: 100% coverage for workmanship errors for:

   a. 10 years.

4. Warranted against algae discoloration for 10 years.

PART 2 - PRODUCTS

2.1 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

A. Laminated-Strip Asphalt Shingles: ASTM D 3462, laminated, multi-ply overlay construction, glass-fiber reinforced, mineral-granule surfaced, and self-sealing.

1. Basis-of-Design Product: Subject to compliance with requirements and confirmation of existing manufacturer/system, provide the following or comparable product:

   Granule surfaced, self-sealing asphalt shingle with a strong fiberglass reinforced Micro Weave core and StainGuard protection, which prevents pronounced discoloration from blue-green algae through formulation/unique blends of granules. Dovetail cut tabs and bold shadow lines provide a slate appearance with a 7 1/2 in. exposure. UL 790 Class A rated with UL 997 Wind Resistance Label; ASTM D 7158, Class H; ASTM D 3161, Type 1; ASTM D 3018, Type 1; ASTM D 3462; AC438 compliant; CSA 123.5-98; Slateline Lifetime Designer Shingles, by GAF; or provide approved equal from the following:

   a. Certainteed
   b. Owens-Corning

2. Butt Edge: Straight cut.
3. Strip Size: Manufacturer's standard.
4. Algae Resistance: Granules treated to resist algae discoloration.
5. Color and Blends: As selected by the Professional from manufacturer’s full range.
6. Premium starter strip shingles

2.2 UNDERLAYMENT MATERIALS

A. Sheet Underlayment, Premium Non-Asphaltic, Polypropylene construction GAF Tiger Paw Premium Roof Deck Protection or equal: ASTM D8257.

2.3 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.

B. Vapor retarder: GAF SA Storm Guard Leak Barrier or approved equal from Certainteed or Owens-Corning.

C. Roofing Nails: ASTM F 1667; aluminum, stainless-steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch-(3-mm-)diameter, smooth shank, sharp-pointed, with a minimum 3/8-inch-(9.5-mm-)diameter flat head and of sufficient length to penetrate 3/4 inch (19 mm) into solid wood decking or extend at least 1/8 inch (3 mm) through OSB or plywood sheathing.

1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

D. Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire with low-profile plastic capped heads, 1-inch (25-mm) minimum diameter.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored; and that provision has been made for flashings and penetrations through asphalt shingles.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

B. Single-Layer Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides a minimum of 2 inches (50 mm) over underlying course. Lap ends a minimum of 4 inches (100 mm). Stagger end laps between succeeding courses at least 72 inches (1830 mm). Fasten with felt underlayment nails.

1. Install underlayment on roof deck not covered by self-adhering sheet underlayment. Lap sides of felt over self-adhering sheet underlayment not less than 3 inches (75 mm) in direction to shed water. Lap ends of felt not less than 6 inches (150 mm) over self-adhering sheet underlayment.
2. Install fasteners at no more than 36 inch (900 mm) o.c.

C. Double-Layer Underlayment: Required for low slope areas 2:12 slope to less than 4:12.

3.3 ASPHALT SHINGLE INSTALLATION

A. General: Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

B. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip with tabs removed at least 7 inches (175 mm) wide with self-sealing strip face up at roof edge.

1. Extend asphalt shingles 1/2 inch (13 mm) over fasciae at eaves and rakes.
2. Install starter strip along rake edge.

C. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

D. Install asphalt shingles by single-strip column or racking method, maintaining uniform exposure. Install full-length first course followed by cut second course, repeating alternating pattern in succeeding courses.

E. Fasten asphalt shingle strips with a minimum of four roofing nails located according to manufacturer's written instructions.

1. Where roof slope is less than 4:12, seal asphalt shingles with asphalt roofing cement spots.
2. When ambient temperature during installation is below 50 deg F (10 deg C), seal asphalt shingles with asphalt roofing cement spots.

END OF SECTION 07 31 13

SECTION 07 54 16 - KETONE ETHYLENE ESTER (KEE) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Adhered thermoplastic KEE roofing system on wood deck, including:

2. Substrate board.

3. Vapor retarder.

4. Roof insulation.

5. Roof insulation cover board.

6. Walkways.

B. Related Sections:

1. Division 06 Section "Miscellaneous Rough Carpentry" for wood nailers and blocking.

2. Division 07 Section "Preparation for Re-Roofing" for removal of existing roofing; inspection, repair and replacement of existing deck/substrate, if required to receive new roofing.

3. Division 07 Section "Sheet Metal Flashing and Trim" for shop-formed sheet metal items including roof drainage system items, roof penetration flashings, base and counterflashings and reglets.

4. Division 07 Section "Roof Specialties" for manufactured copings, roof edge flashings and counterflashings, and roof edge drainage systems.

5. Division 06 Section 06 16 00 “Sheathing.”

1.3 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D1079 "Standard Terminology Relating to Roofing and Waterproofing" and applicable edition of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" and NRCA's Glossary for definition of terms related to roofing work in this Section.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.

2. Review drawings and specifications.

3. Review methods and procedures related to roofing installation, including manufacturer's written instructions.

4. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

5. Examine substrate conditions and finishes for compliance with requirements, including flatness and fastening.

6. Review structural loading limitations of roof deck during and after roofing.

7. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.

8. Review governing regulations and requirements for insurance and certificates if applicable.

9. Review temporary protection requirements for roofing system during and after installation.

10. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Sustainable Design Submittals:

1. Product Test Reports for Solar Reflectance: For roof materials, indicating that roof materials comply with Solar Reflectance Index requirement.

2. Product Data and Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-VOC/low-emitting materials.

C. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.

1. Provide roof plan showing orientation and types of roof deck, orientation of membrane roofing, and fastener spacings and patterns for mechanically fastened components.

2. Base flashings and membrane terminations.

a. Indicate details meet requirements of NRCA and FM required by this Section.

3. Layout and thickness of insulation.

4. Tapered insulation layout, including slopes.

5. Crickets, saddles, and tapered edge strips, including slopes.

6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

7. Membrane securement, fastening or adhesion requirements.

D. Samples for Verification: For the following products:

1. Sheet roofing materials and base flashing, of type and color specified, including T-shaped side and end lap seam.

2. Roof insulation and cover board.

3. Walkway materials.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For Installer.

1. Letter written for this Project indicating manufacturer approval of Installer.

B. Contractor's Product Certificate: Submit signed certification, on company letterhead, indicating products intended for Work of this Section, including product names and numbers and manufacturers' names, with statement indicating that products to be provided meet the requirements of the Contract Documents.

C. Manufacturer Certificates:

1. Submit evidence of compliance with specified requirements in "Performance Requirements" Article.

a. Include: External fire resistance submittal and Wind uplift resistance submittal.

2. Product Compatibility: Indicate manufacturer has verified compatibility of roofing system components, including but not limited to: Roofing membrane, flashing sheets, adhesives, and sealants.

D. Warranties: Unexecuted sample copies of special warranties.

E. Field Quality Control Reports:

1. Field Test Reports:

a. Concrete internal relative humidity test reports.

b. Fastener pullout test results and manufacturer's revised requirements for fastener patterns.

c. Test results and recommendations for fastening wood nailers according to ANSI/SPRI/FM 4435 ES-1.

2. Inspection Reports: Reports of Roofing Inspector. Include weather conditions, description of work performed, tests performed, defective work observed, and corrective actions taken to correct defective work.

a. Submit reports within 48 hours after inspection.

F. Manufacturer's Instructions: Submit copy of manufacturer's written installation instructions for specified roofing system.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: To include in maintenance manuals.

B. Executed copies of warranties.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and certified by manufacturer, including a full-time on-site supervisor with a minimum of five years' experience installing products comparable to those specified, able to communicate verbally with Contractor, Architect, and employees, and qualified by the manufacturer to install manufacturer's product and furnish warranty of type specified.

B. Manufacturer Qualifications: Approved manufacturer with roofing systems comparable to that specified for this Project, with minimum five years' experience in manufacture of thermoplastic roof membrane products in successful use in similar applications.

1. Approval of Comparable Products: Submit the following in accordance with project substitution requirements, within time allowed for substitution review:

a. Contractor's Product Certificate: Submit notarized certificate, indicating products intended for Work of this Section, including product names and numbers and manufacturer names, with statement indicating that products to be provided meet the requirements of the Contract Documents.

b. Product data, including certified independent test data indicating compliance with requirements.

c. Samples of each component.

d. Sample submittal from similar project.

e. Project references: Minimum of five installations of specified products not less than five years old, with Owner contact information.

f. Sample warranty.

2. Substitutions following award of contract are not allowed.

3. Approved manufacturers must meet separate requirements of Submittals Article.

C. Roofing Inspector Qualifications: A technical representative of manufacturer not engaged in the sale of products and experienced in the installation and maintenance of the specified roofing system, qualified to perform roofing observation and inspection specified in Field Quality Control Article, to determine Installer's compliance with the requirements of this Project, and approved by the manufacturer to issue warranty certification. The Roofing Inspector shall be one of the following:

1. An authorized full-time technical employee of the manufacturer.

2. An independent party certified as a Registered Roof Observer by the International Institute of Building Enclosure Consultants (formerly the Roof Consultants Institute) retained by the Contractor or the Manufacturer and approved by the Manufacturer.

D. Manufacturer's Installation Instructions: Obtain and maintain on-site access to manufacturer's written recommendations and instructions for installation of products.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.

1. Protect stored liquid material from direct sunlight.

2. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources.

1. Store in a dry location.

2. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.10 PROJECT / FIELD CONDITIONS

A. Protect building, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from roofing operations.

B. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.

C. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

D. Daily Protection: Coordinate installation of roofing so insulation and other components of roofing system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

1. Provide tie-offs at end of each day's work to cover exposed roofing and insulation with a course of roofing sheet securely in place with joints and edges sealed, weathertight.

2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing.

3. Remove temporary plugs from roof drains at end of each day.

4. Remove and discard temporary seals before beginning work on adjoining roofing.

E. Owner will occupy portions of building immediately below roofing area. Conduct roofing so Owner's operations will not be disrupted. Provide Owner with not less than 72 hours' notice of activities that may affect Owner's operations.

1.11 WARRANTY

A. Manufacturer's Warranty: Roof System Manufacturer's standard form in which Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within warranty period, as follows.

1. Form of Warranty: Manufacturer's standard warranty form.

2. Scope of Warranty: Work of this Section and including sheet metal details and termination details installed by the roof system Installer and approved by the Roof System Manufacturer.

3. Warranty Period: 30 years from date of completion.

B. Manufacturer Inspection Services: By manufacturer's technical representative, to report maintenance responsibilities to Owner necessary for preservation of Owner's warranty rights. The cost of manufacturer's inspections is included in the Contract Sum.

1. Inspections to occur in following years: 2, 5, 10, 15, 20 and 25 following completion.

C. Installer Warranty: Installer's warranty signed by Installer, as follows.

1. Form of Warranty: Form included in Project Manual.

2. Scope of Warranty: Work of this Section.

3. Warranty Period: 2 years from date of completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: The roof system specified in this Section is based upon products of Tremco CPG Inc, Beachwood, OH, (800) 562-2728, www.tremcoroofing.com that are named in other Part 2 articles. Provide specified products or comparable products of one of the following.

1. Ecology Roof Systems.

2. U.S. Ply Inc.

3. Manufacturers of comparable products: Approved by Architect prior to bid.

B. Source Limitations: Obtain components for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

1. Accelerated Weathering: Roofing system shall withstand 10,000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.

2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746/D3746M, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

B. Material Compatibility: Roofing system materials to be compatible with one another and adjacent materials under conditions of service and installation required, as demonstrated by roofing membrane manufacturer based on testing and field experience.

C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency in accordance with ANSI/FM 4474, UL 580, or UL 1897, and to resist uplift pressures calculated in accordance with ASCE-7 and applicable code.

D. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings tested according to ANSI/SPRI/FM 4435 ES-1, capable of resisting design pressures calculated in accordance with ASCE-7 and applicable code.

E. Flashings and Fastening: Provide base flashings, perimeter flashings, detail flashings and component materials and installation techniques that comply with requirements and recommendations of the following:

1. Roofing system manufacturer’s details and recommendations.

2. FM 1-49: Loss Prevention Data Sheet for Perimeter Flashings.

3. FM 1-29: Loss Prevention Data Sheet for Above Deck Roof Components.

4. NRCA Roofing Manual for construction details and recommendations.

5. SMACNA Architectural Sheet Metal Manual for construction details.

6. Comply with requirements of Division 07 Section "Sheet Metal Flashing and Trim" and Roof Specialties".

F. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

2.3 MATERIALS, GENERAL

A. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

2.4 THERMOPLASTIC MEMBRANE MATERIALS

A. KEE Roof Membrane:

1. Thermoplastic Ketone Ethylene Ester (KEE) coated polyester fabric-reinforced fleece-backed sheet, ASTM D6754.

a. Basis of design product: Tremco, TremPly KEE FB Single Ply Roof Membrane.

b. Breaking Strength, minimum, ASTM D751: Machine direction, 500 lbf (87 kN/m); Cross machine direction 400 lbf (70 kN/m).

c. Tear Strength, minimum, ASTM D751: Machine direction, 125 lbf (22 kN/m); Cross machine direction (145 lbf (25 kN/m).

d. Elongation at Break, ASTM D751: 20 percent.

e. Dynamic Impact/Puncture Resistance, ASTM D5635: 30 J, minimum.

f. Minimum Membrane Thickness, nominal, less backing, ASTM D751: 60 mils (1.5 mm).

g. Thickness over fiber, optical method: 0.016 inches (0.406 mm).

h. Accelerated Weathering, ASTM G155 and ASTM G154: Not greater than 15,000 hr., no cracking or crazing.

i. Abrasion Resistance, ASTM D3389: Not greater than 2,000 cycles, H-18 wheel, 1,000 g load.

j. Color: Gray.

k. Solar Reflectance Index (SRI), ASTM E1980: 110 (White, initial), 86 (White, 3-yr aged).

2.5 BASE FLASHING MATERIALS

A. Sheet Flashing: Manufacturer's standard, smooth-backed, sheet flashing of same material, type, reinforcement, thickness and color as KEE roof membrane.

2.6 ADHESIVE MATERIALS

A. General: Adhesive and sealant materials recommended by roofing system manufacturer for intended use and compatible with roofing membrane.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

2. Membrane Bonding Adhesive:

   a. Bonding adhesive, waterborne low-VOC, for bonding KEE fleece-backed single ply membranes and flashings to substrates.

      1) Basis of design product: Tremco, TremPly KEE FB WBII Bonding Adhesive.

      2) VOC, maximum, ASTM D3960: 153 g/L.

3. Flashing Membrane Adhesive:

   a. Bonding adhesive, solvent based fast drying, VOC-compliant, for bonding KEE smooth-backed single ply membranes and flashings to substrates.

      1) Basis of design product: Tremco, TremPly KEE LV Bonding Adhesive.

      2) VOC, maximum, ASTM D 3960: 200 g/L.

2.7 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.

B. Prefabricated Flashings: As recommended by roof membrane manufacturer, for pipe, penetration and miscellaneous flashings.

C. Fasteners, General: Factory-coated steel fasteners and metal plates meeting corrosion-resistance provisions in FM 4470, designed for fastening roofing components to substrate, tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.

   1. Use fasteners of type listed in manufacturer’s tested assembly for required wind uplift resistance.

D. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch (25 mm wide by 1.3 mm) thick, prepunched.

E. Metal Flashing Sheet: Metal flashing sheet is specified in Division 07 Section "Sheet Metal Flashing and Trim."

F. Joint Sealant: Elastomeric joint sealant compatible with roofing materials, with movement capability appropriate for application.

   1. Joint Sealant, Polyurethane: ASTM C920, Type S, Grade NS, Class 50 single-component moisture curing sealant, formulated for compatibility and use in dynamic and static joints; paintable.

      a. Basis of design product: Tremco, TremSEAL Pro.

      b. Volatile Organic Compounds (VOC), maximum, ASTM D3960: 40 g/L.

      c. Hardness, Shore A, ASTM C661: 40.

      d. Adhesion to Concrete, ASTM C794: 35 pli.

      e. Tensile Strength, ASTM D412: 350 psi (2410 kPa).

      f. Color: Closest match to substrate.

G. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories, as recommended by roofing system manufacturer.

2.8 SUBSTRATE BOARDS

A. Substrate / Thermal Protection Board:

1. Gypsum panel, glass-mat-faced, primed, ASTM C1177/C1177M.

a. Basis of design product: Tremco/GP Gypsum DensDeck Prime.

b. Thickness: 1/2 inch (12 mm).

2. Gypsum panel, cellulosic fiber reinforced, water-resistant, ASTM C1278/C1278M.

a. Basis of design product: Tremco/USG Securock, Gypsum-Fiber Roof Board.

b. Thickness: 1/2 inch (13 mm).

2.9 VAPOR RETARDER

A. Vapor Retarder:

1. SBS-modified asphalt coated composite polyester/fiberglass/fiberglass mat reinforced high tensile strength base sheet, ASTM D4601 Type II.

a. Basis of design product: Tremco, BURmastic Composite Ply HT.

b. Tensile Strength at 77 deg. F (25 deg. C), minimum, ASTM D5147: Machine direction, 165 lbf/in (725 N); Cross machine direction, 150 lbf/in (660 N).

c. Tear Strength at 77 deg. F (25 deg. C), minimum, ASTM D5147: Machine direction, 260 lbf (1150 N); Cross machine direction, 230 lbf (1120 N).

d. Thickness, minimum, ASTM D5147: 0.060 inch (1.5 mm).

B. Vapor Retarder Adhesive:

1. Cold-applied bio-based low odor urethane roofing adhesive, two-part, USDA BioPreferred, formulated for compatibility and use with specified roofing membranes and flashings.

a. Basis of design product: Tremco, POWERply Endure BIO Adhesive TF.

b. Volatile Organic Compounds (VOC), maximum, ASTM D3690: 0 g/L.

c. Low Temperature Flexibility, ASTM D2240: Pass at -30 deg F (-34 deg C).

d. Solids, by Volume, ASTM D2697: 100 percent.

e. Biobased Content, Minimum, ASTM D6866: 70 percent.

2.10 ROOF INSULATION AND INSULATION ACCESSORIES

A. Roof Insulation, General: Preformed roof insulation boards manufactured or approved by roofing manufacturer, selected from insulation manufacturer's standard sizes, suitable for application, and of thicknesses indicated. Provide roof insulation accessories recommended by insulation manufacturer for intended use and compatible with roofing.

1. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/8 inch per 12 inches (1:96) unless otherwise indicated.

2. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated, not less than two times the roof slope.

B. Roof Insulation:

1. Board Insulation, Polyisocyanurate: CFC- and HCFC- free, with recycled content glass-fiber mat facer on both major surfaces, ASTM C1289 Type II Class 1.

a. Compressive Strength, ASTM D1621: Grade 2: 20 psi (138 kPa).

b. Conditioned Thermal Resistance at 75 deg. F (24 deg. C): 14.4 at 2.5 inches (50.8 mm) thick.

C. Insulation Cover Board:

1. Gypsum panel, glass-mat-faced, primed, ASTM C1177/C1177M.

a. Basis of design product: Tremco/GP Gypsum DensDeck Prime.

b. Thickness: 1/2 inch (12 mm).

2. Gypsum panel, cellulosic fiber reinforced, water-resistant, ASTM C1278/C1278M.

a. Basis of design product: Tremco/USG Securock, Gypsum-Fiber Roof Board.

b. Thickness: 1/2 inch (13 mm).

D. Roof Insulation and Cover Board Adhesive:

1. Urethane adhesive, bead-applied, low-rise two-component solvent-free low odor, formulated to adhere roof insulation to substrate.

a. Basis of design product: Tremco, Low Rise Foam Insulation Adhesive.

b. Flame Spread Index, ASTM E84: 10.

c. Smoke Developed Index, ASTM E84: 30.

d. Volatile Organic Compounds (VOC), maximum, ASTM D3960: 0 g/L.

e. Tensile Strength, minimum, ASTM D412: 250 psi (1720 kPa).

f. Peel Adhesion, minimum, ASTM D903: 17 lbf/in (2.50 kN/m).

g. Flexibility, 70 deg. F (39 deg. C), ASTM D816: Pass.

E. Insulation Cant Strips: ASTM C 208, Type II, Grade 1, cellulosic-fiber insulation board.

F. Tapered Edge Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.

G. Substrate Joint Tape: 6- or 8-inch- (150- or 200-mm-) wide, coated, glass fiber.

2.11 WALKWAY MATERIALS

A. Walkway Material:

1. Protection walkway roll, reinforced KEE membrane roll with diamond-tread, slip-resistant surface, fabricated for heat welding to compatible KEE membrane surface.

a. Basis of design product: Tremco, TremPly KEE Protection Walkway Roll.

b. Roll Size: 30 inches by 100 ft (760 mm by 25.4 m).

c. Thickness: 0.060 inch (1.5 mm).

d. Breaking strength: 450 lbs (77 kN/m).

e. Color: Light Gray.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.

2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

a. Verify that perimeter nailers for copings and roof edge flashings are securely fastened according to ANSI/SPRI/FM 4435 ES-1, FM DS 1-49, and applicable code, to resist uplift pressures.

3. Verify that substrate is sound and dry.

4. Wood Roof Deck: Verify that deck shows no signs of damage, rot or deterioration, and is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch (1.6 mm) out of plane relative to adjoining deck.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove existing roofing and protect existing building in accordance with requirements of Division 07 Section "Preparation for Re-Roofing."

B. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

C. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

D. Protect existing roofing system that is indicated to remain, and adjacent portions of building and building equipment.

1. Limit traffic and material storage to areas of existing roofing membrane that have been protected.

2. Maintain temporary protection and leave in place until replacement roofing has been completed.

E. Verify that rooftop utilities and service piping affected by the Work have been shut off before commencing Work.

F. Shut down air intake equipment in the vicinity of the Work in coordination with the Owner. Cover air intake louvers before proceeding with roofing work that could affect indoor air quality or activate smoke detectors in the ductwork.

3.3 INSTALLATION, GENERAL

A. Install roofing system in accordance with manufacturer’s written instructions and approved details.

B. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition.

C. Cooperate with testing agencies engaged or required to perform services for installing roofing system.

3.4 ROOFING INSTALLATION DETAILS

A. NRCA Installation Details: Install roofing system in accordance with applicable NRCA Manual Plates and NRCA recommendations; modify as required to comply with manufacturer's approved details and perimeter fastening requirements of FM references if applicable.

3.5 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

1. Fasten substrate board to deck to resist uplift pressure at corners, perimeter, and field of roof according to membrane roofing system manufacturers' written instructions.

3.6 VAPOR RETARDER INSTALLATION

A. Vapor Retarder Installation, General: Completely seal vapor retarder/air barrier at terminations, obstructions, and penetrations to prevent air movement into roofing system. Seal vapor retarder/air barrier to air barrier in adjacent construction at perimeter of roofing system.

B. SBS Modified Sheet Vapor Retarder: Install one lapped vapor retarder course and adhere in a uniform application of cold-applied adhesive, according to roofing system manufacturer's written instructions.

3.7 INSULATION AND INSULATION ACCESSORIES INSTALLATION

A. Comply with roofing manufacturer's and insulation manufacturer’s written instructions for installing roof insulation.

B. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

C. Cant Strips: Install and secure preformed 45-degree cant strips at junctures of built-up roofing with vertical surfaces or angle changes greater than 45 degrees.

D. Tapered Insulation and Crickets: Install tapered insulation under area of roofing to conform to slopes indicated.

1. Where crickets are indicated or required to provide positive slope to drain, make slope of crickets minimum of two times the roof slope, not less than 1/4 inch in 12 inches (1:48).

E. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

F. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (70 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

1. Install insulation at thickness indicated on approved shop drawings.

2. Insulation Drain Sumps: Tapered insulation sumps, not less than 2 by 2 ft. (600 by 600 mm), sloped to roof drain.

a. Sump to maximum depth of not more than 1 inch (25 mm) less than the Project-stipulated continuous insulation thickness based upon code requirements.

1) Where Average Insulation R-value is permitted, maintain minimum 1 inch (25 mm) insulation thickness at low point.

G. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

H. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

I. Insulation Installation Method:

1. Adhered Insulation Application Method: Install each layer of insulation and adhere to substrate as follows:

a. Prime substrate with primer as recommended by manufacturer and allow to dry.

b. Adhere insulation to resist uplift pressure at corners, perimeter, and field of roof.

1) Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

J. Cover Board Installation:

1. Comply with roofing system and cover board manufacturer's written installation instructions.

2. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together. Tape joints if required by roofing manufacturer.

a. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.

b. At internal roof drains, conform to slope of drain sump.

c. Trim cover board, so that water flow is unrestricted.

d. Cut and fit cover board tight to nailers, projections, and penetrations.

3. Adhere cover boards to resist uplift pressure at corners, perimeter, and field of roof.

3.8 ADHERED MEMBRANE ROOFING INSTALLATION

A. Adhere membrane roofing over area to receive roofing and install according to membrane roofing system manufacturer's written instructions.

B. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.

C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Water-Based Bonding Adhesive: Apply to substrate at rate required by manufacturer. Install membrane immediately into adhesive, avoiding any air entrapment; do not allow adhesive to dry. Roll membrane into wet adhesive. Do not apply adhesive to splice area of membrane.

E. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeter of roofing.

F. Apply membrane roofing with side laps shingled with slope of roof deck where possible.

G. Welded Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.

2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.

3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

H. Spread sealant bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

3.9 BASE FLASHING INSTALLATION

A. Membrane Flashings: Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

1. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

2. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

3. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

4. Seal top termination of base flashing with a metal termination bar and a continuous bead of joint sealant.

B. Extend base flashing up walls or parapets a distance of 8-12 inches (200-300 mm) above roofing and 6 inches (150 mm) onto field of roofing, unless otherwise recommended by roofing manufacturer.

1. Comply with roofing manufacturer’s and NRCA details.

3.10 WALKWAY INSTALLATION

A. Walkways, General: Install walkways according to roofing manufacturer's written instructions.

1. Install walkways at following locations:

a. Where indicated on Drawings.

B. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.11 FIELD QUALITY CONTROL

A. Roofing Inspector: Contractor shall engage a qualified roofing inspector to perform roof tests and inspections and to prepare test reports.

1. Engage a qualified roofing inspector for a minimum of five full-time days on site, per 40-hour crew week, to perform roof tests and inspections and to prepare start up, interim, and final reports. Roofing Inspector's quality assurance inspections shall comply with applicable criteria established in NRCA's "Quality Control and Quality-assurance Guidelines for the Application of Membrane Roofing Systems."

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

1. Notify Architect 48 hours in advance of date and time of inspection.

C. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

1. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.12 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect.

B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.13 SCHEDULE OF ROOF ASSEMBLIES

A. Roof Type A:

1. Wood deck;

2. Thermal Barrier / Substrate Board: ½-inch Securock Gypsum Fiber Roof Board Type X or DensDeck Prime Type X Roof Board, mechanically fastened;

3. Vapor Retarder: Tremco, BURmastic Composite Ply HT, adhered with Tremco, POWERply Endure BIO Adhesive-TF;

4. Insulation: Polyisocyanurate insulation, adhered with Tremco, Low-Rise Foam Insulation Adhesive;

5. Insulation Cover Board: ½-inch Securock Gypsum Fiber Roof Board or DensDeck Prime Roof Board, adhered with Tremco, Low-Rise Foam Insulation Adhesive;

6. Roof Membrane: 60-mil Tremco, TremPly KEE membrane, adhered with Tremco, TremPly KEE WBII Bonding Adhesive.

B. Roof Type B:

1. Wood deck, structural insulated panels (SIP);

2. Thermal Barrier / Substrate Board: ½-inch Securock Gypsum Fiber Roof Board or DensDeck Prime Roof Board, over ¾-inch plywood, mechanically fastened;

3. Insulation: Polyisocyanurate insulation, adhered with Tremco, Low-Rise Foam Insulation Adhesive;

4. Roof Membrane: 60-mil Tremco, TremPly KEE membrane, adhered with Tremco, TremPly KEE WBII Bonding Adhesive.

C. Roof Type C:

1. Metal deck;

2. Tapered Insulation: Polyisocyanurate insulation, mechanically fastened;

3. Roof Membrane: 60-mil Tremco, TremPly KEE membrane.

END OF SECTION 07 54 16

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Formed roof-drainage sheet metal fabrications.
2. Formed low-slope roof sheet metal fabrications.
3. Manufactured reglets and counterflashings.
4. Miscellaneous sheet metal flashing and trim.

B. Related Requirements:

1. Section 04 20 00 “Unit Masonry” for installing through-wall flashings, reglets in masonry construction.
2. Section 06 10 53 “Miscellaneous Rough Carpentry” for wood nailers, curbs, and blocking.
3. Division 22 Section “Storm Drainage Piping Specialties”: Roof drains incorporated in roof system.

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.

a. Indicate details meet requirements of “SMACNA”, “NRCA”, and “FMG”.

2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, overflow scuppers and scupper boxes.
10. Include details of special conditions.
11. Include details of connections to adjoining work.

C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested and FM Approvals approved.

C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

D. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

B. Warranties: Manufacturer's executed warranty documents. Submit prior to acceptance of Work.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1. For roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved, shop shall be listed as able to fabricate required details as tested and approved.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockup of typical roof edge, including fascia trim, approximately 10 feet (3.0 m) long, including supporting construction cleats, seams, attachments, and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry. Protect stored sheet metal flashing and trim from contact with water.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.10 WARRANTY

A. Refer to warranty requirements of Division 07 Sections “Membrane Roofing Cutting and Patching” and Polyvinyl – Chloride PVC-KEE Retention “Blue” Roofing System, for terms and conditions of warranties covering work of this Section.

B. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 30 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Flashings and Fastening: Comply with requirements of Division 07 roofing sections. Provide base flashings, perimeter flashings, detail flashings and component materials and installation techniques that comply with requirements and recommendations of the following:

1. FM Global 1-49: "Property Loss Prevention Data Sheet for Perimeter Flashings."
2. FM Global 1-29: "Property Loss Prevention Data Sheet for Above Deck Roof Components."
3. NRCA: "The NRCA Roofing Manual" for construction details and recommendations.

D. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:

1. Design Pressure: 90 PSF.

E. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

F. FM Approvals Listing: Manufacture and install copings, roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with name of fabricator and design approved by FM Approvals.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.

1. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1) Color: As selected by Architect.

2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

C. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 or H01 temper.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hussey Copper Ltd.
b. Revere Copper Products, Inc.

2. Finish: Nonpainted- Mill

D. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed; with smooth, flat surface.

1. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

E. Lead Sheet: ASTM B749 Lead Sheet.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Copper Sheet: Copper, hardware bronze or passivated Series 300 stainless steel.

3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
5. Fasteners for Zinc-Coated (Galvanized) and Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

C. Solder:

1. For Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.

2. For Stainless Steel: ASTM B 32, with acid flux of type recommended by stainless-steel sheet manufacturer.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane, polysulfide, or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

H. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.

I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.4 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.

1. Low-Temperature Flexibility: ASTM D1970; passes after testing at minus 20 deg F (29 deg C) or lower.

2.5 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

G. Seams, Soldered: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

H. Seams for stainless steel and copper solder: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

I. Seams for Uncoated Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.

J. Do not use graphite pencils to mark metal surfaces.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Downspouts: Size 4 dia. formed from .063 inch thick formed aluminum or .125 inch extruded aluminum. Fabricate in 10-foot (3-m) long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish to match manufactured fasica system.

1. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. between.
2. Provide elbows at base and of downspouts to direct water away from face of building
3. Connect downspouts to underground drainage system as indicated.

B. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch- (100-mm-) wide wall flanges to interior, and base extending 4 inches (100 mm) beyond cant or tapered strip into field of roof. Fabricate from the following materials:

1. Aluminum: 0.050 inch (1.27mm) thick.
2. Finish: Match gutters and downspouts.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof and Roof-to-Wall Transition Expansion-Joint Cover: Fabricate from the following materials: Shop fabricate interior and exterior corners.

1. Stainless Steel: 0.025 inch (0.64 mm) thick.
2. Aluminum-Zinc Alloy-Coated Steel: 0.034 inch (0.86 mm) thick.

B. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Copper: 16 oz./sq. ft (0.55 mm thick).

C. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Aluminum: 0.032 inch (0.81 mm) thick.
2. Stainless Steel: 0.025 inch (0.64 mm) thick.
3. Galvanized Steel or Aluminum-Zinc Alloy-Coated Steel: 24 gage/0.028 inch (0.71 mm) thick, minimum.

D. Flashing Receivers: Fabricate from the following materials:

1. Aluminum: 0.032 inch (0.81 mm) thick.
2. Stainless Steel: 0.025 inch (0.64 mm) thick.
3. Galvanized Steel or Aluminum-Zinc Alloy-Coated Steel: 24 gage/0.028 inch (0.71 mm) thick, minimum.

E. Roof-Penetration Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.019 inch (0.48 mm) thick.
2. Copper: 22 Mil/16 Ounce Copper (.0216 inch) 24 gauge.

F. Roof-Drain Flashing: Fabricate from the following materials:

1. Copper: 12 oz./sq. ft. (0.41 mm thick).

2.8 REGLETS AND COUNTERFLASHINGS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Tremco, TremLock Counterflashing.

B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:

1. Extruded Aluminum: 0.100 inch (2.54 mm) thick.
2. Corners: Factory prefabricated.
3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
4. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in cut masonry mortar joint.

C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) and in lengths not exceeding 12 feet (3.6 m) designed to snap into reglets and compress against base flashings with joints lapped, from the following exposed metal:

1. Extruded Aluminum: 0.032 inch (0.81 mm) thick.

D. Accessories:

1. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

E. Aluminum Finish: Two-coat fluoropolymer.

1. Color: To match manufactured fascia system.

2.9 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:

1. Copper: 16 oz./sq. ft. (0.55 mm thick).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.
6. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members

for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).

2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches (38 mm); however, reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Do not solder aluminum sheet.
2. Do not use torches for soldering.
3. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
4. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.
5. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

3.3 ROOF-DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Parapet Scuppers: Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

1. Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.
2. Seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.

3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.

C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints minimum of 4 inches (100 mm). Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant, interlocking folded seam or blind rivets and sealant, anchor and washer at 36-inch (910-mm) centers unless otherwise indicated.

D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 04 20 00 "Unit Masonry."

C. Reglets: Installation of reglets is specified in Section 04 20 00 "Unit Masonry."

D. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 8 inches (200 mm) beyond wall openings.

3.6 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.7 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.8 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 62 00

SECTION 07 71 00 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Manufactured copings.
2. Manufactured reglets and counterflashings.

B. Related Information:

1. Division 03 Section "Cast-in-Place Concrete" for installing reglets in new work.
2. Division 04 Section "Unit Masonry Assemblies" for installing reglets in new work.
3. Division 06 Section "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
4. Division 07 Section "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
5. Division 07 Section "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site, in conjunction with roofing preinstallation conference specified in Division 07 roofing section.

1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects roof specialties including installers of roofing materials and accessories.
2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof specialties.

1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.
2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
4. Detail termination points and assemblies, including fixed points.
5. Include details of special conditions.

C. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.

D. Samples for Verification: For each roof specialty product made from 12-inch (300-mm) lengths of full-size components including fasteners, cover joints, accessories, and attachments.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for copings and roof-edge flashings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Certificates: Provide manufacturer's certificates for copings and roof-edge specialties indicating compliance with performance requirements including the following:

1. ANSI/SPRI/FM 4435/ES-1 compliance.
2. FM Approvals listing

C. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class and ANSI/SPRI ES-1 tested to specified design pressure.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and set quality standards for fabrication and installation.

1. Build mockup of typical roof edge, including fascia, approximately 6 feet (1829 mm) long, including supporting construction, seams, attachments, underlayment, and accessories.
2. Build mockup of typical roof edge, including coping, approximately 10 feet (3.0 m) long, including supporting construction, seams, attachments, underlayment, and accessories.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof specialties installation.

1.9 PROJECT / FIELD CONDITIONS

A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.

B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Division 07 roofing Section.

B. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. FM Approvals' Listing: Manufacture and install copings and fasciae that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1- 90. Identify materials with FM Approvals' markings.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

D. SPRI Wind Design Standard: Manufacture and install copings tested according to ANSI/SPRI ES-1.

1. Design Pressure: As indicated on Drawings.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 MANUFACTURERS

A. Basis of Design: The roof system specified in this Section is based upon products of Tremco CPG Inc, Beachwood, OH, (800) 562-2728, www.tremcoroofing.com that are named in other Part 2 articles. Provide specified products or comparable products of one of the following.

1. Manufacturers of comparable products: Approved by Architect prior to bid.

B. Source Limitations: Obtain roof specialties approved by manufacturer providing roofing-system warranty specified in Division 07 roofing Section.

2.3 EXPOSED METALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 (Z275) coating designation.

1. Surface: Smooth, flat finish as indicated.

2.4 CONCEALED METALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 (Z275) coating designation.

2.5 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 mils (0.76 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper/film backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: ASTM D1970/D1970M; stable after testing at 225 deg F (107 deg C).
2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F (29 deg C).

B. Slip Sheet: Building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum, rosin sized.

2.6 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.

C. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

E. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

2.7 MANUFACTURED ROOF-EDGE SPECIALTIES

A. Roof-Edge Fascia: Snap-on type fascia with vertical profile.

1. Description: Manufactured two-piece roof-edge fasciae systems consisting of formed-metal fascia covers in section lengths not exceeding 12 feet (3.6 m), with an extruded anchor bar to engage and secure fascia cover, and concealed splice plates. Provide matching prefabricated continuously welded corner units.

a. Roof-Edge Fasciae Profile: As indicated on Drawings.
b. Splice Plates: Of same material and finish as roof edge flashing units, 8 inches (203 mm) long with factory-installed dual non-curling butyl sealant strips.

2. Basis-of-Design Product: Tremco, TremLock 215 H.D. Fascia.
3. Fascia Cover Securement: Snap-on, over continuous extruded aluminum anchor bar.
4. Roofing System: Built-up.
5. Fascia Cover Material: Formed aluminum sheet, nominal 0.050-inch (1.27-mm) thickness.

a. Finish: High-performance organic (PVDF) coating.
b. Color: As selected by Architect from manufacturer's full range.

B. Fascia Accessories: Provide accessories fabricated from the same materials and for compatibility with roof edge system; provide the following accessories:

1. Fascia extenders.
2. Wall cap.
3. Overflow scuppers.
4. Spill-out scuppers.
5. Downspout scuppers with integral conductor head and downspout adapters.

2.8 ROOF-EDGE DRAINAGE SYSTEMS

A. Subject to compliance with requirements, provide gutters and downspouts by one of the following manufacturers:

1. ATAS
2. Berridge
3. Alcoa
4. Firestone

B. Gutters: Manufactured in uniform section lengths not exceeding 12 feet (3.6 m), with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch (25 mm) above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.

1. Aluminum Sheet: 0.040 inch thick.
2. Gutter Profile: 6 inch Reverse Bead Half-Round unless otherwise indicated on drawings.
3. Corners: Factory mitered and continuously welded.
4. Gutter Supports: Manufacturer's standard Half-Round Combo Hanser supports as selected by Architect with finish matching the gutters.
5. Gutter Accessories: Continuous hinged leaf guard of solid metal designed to shed leaves, Wire ball downspout strainer, Flat ends.

C. Downspouts: Plain 4 inch round complete with mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.

1. Formed Aluminum: 0.063 inch thick.

D. Aluminum Finish: Two-coat fluoropolymer.

1. Color: As selected by Architect from manufacturer's full range.

2.9 MANUFACTURED COPINGS

A. Copings: Manufactured coping system consisting of formed-metal coping cap in section lengths not exceeding 12 feet (3.6 m), concealed anchorage; corner units, end cap units, and concealed splice plates with same finish as coping caps.

1. Coping Profile: As indicated on Drawings.
2. Basis-of-Design Product: Subject to compliance with requirements, provide Tremco, TremLock Infinity Coping.
3. Coping-Cap Material: Zinc-coated steel, nominal 24 ga.; 0.028-inch (0.71-mm) thickness.

   a. Finish: High-performance organic (PVDF) coating.
   b. Color: As selected by Architect from manufacturer's full range.

4. Corners: Factory mitered and continuously welded.
5. Coping-Cap Attachment Method: Snap-on, fabricated from coping-cap material.
6. Snap-on-Coping Anchor Plates: Concealed, galvanized-steel sheet, 12 inches (300 mm) wide, with integral cleats.

2.10 MANUFACTURED REGLETS AND COUNTERFLASHINGS

A. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces.

1. Fabricate from the following exposed metal:

a. Material: Zinc-coated steel, nominal 24 ga.; 0.028-inch (0.71-mm) thickness.

2. Corners: Factory prefabricated.
3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
4. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in cut masonry mortar joint.
5. Concrete Type, Embedded: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.

B. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) and in lengths not exceeding 12 feet (3.6 m) designed to snap into reglets and compress against base flashings with joints lapped.

1. Fabricate from the following exposed metal:

a. Material: Zinc-coated steel, nominal 24 ga.; 0.028-inch (0.71-mm) thickness.

C. Accessories:

1. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.
2. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.

D. Finishes: High-performance organic (PVDF) coating, Stainless steel finish as indicated and As milled.

1. Color: As selected by Architect from manufacturer's full range.
2. Stainless Steel Finish: ASTM A480/A480M; No. 2B (bright, cold rolled, unpolished) finish.

2.11 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. High-Performance Organic (PVDF) Coating: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with ASTM A755/A755M and coating and resin manufacturers' written instructions.

1. Galvanized Steel Coil Coating Finishes: Two-Coat or Three-Coat Fluoropolymer: AAMA 621 and as additionally required to meet specified finish performance and warranty requirements. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

E. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

F. Stainless Steel Finish: ASTM A480/A480M; No. 2B (bright, cold rolled, unpolished) finish, unless otherwise indicated.

G. Mill Finish: As manufactured.

H. Patinated Finish: Factory pre-patinated finish, as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering Sheet Underlayment: Install wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water. Overlap edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

B. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

3.3 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of self-adhering, high-temperature sheet underlayment.

3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 feet (3.6 m) with no joints within 18 inches (450 mm) of corners or intersections unless otherwise shown on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes:

1. Wood Blocking or Sheathing: Use fasteners of sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.
2. Other Substrates: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints with elastomeric sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for watertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F (4 deg C).

3.4 INSTALLATION OF COPINGS

A. Install clips, cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's required spacing that meets performance requirements.

3.5 INSTALLATION OF REGLETS AND COUNTERFLASHINGS

A. General: Coordinate installation of reglets and counterflashings with installation of base flashings.

B. Embedded Reglets: See Division 03 Section "Cast-in-Place Concrete" and Division 04 Section "Unit Masonry" for installation of reglets.

C. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches (100 mm) over top edge of base flashings.

D. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches (100 mm) over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with elastomeric sealant. Fit counterflashings tightly to base flashings.

3.6 CLEANING AND PROTECTION

A. Clean exposed metal surfaces.

B. Clean off excess sealants.

C. Clean and neutralize flux materials. Clean off excess solder.

D. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

E. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 71 00

SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roof hatches

B. Related Sections:

1. Division 07 Section "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. Railings Structural Requirements

1. Handrail, wall rail and guardrail assemblies and attachments shall withstand a minimum concentrated load of 200 pounds (90719 g) applied horizontally or vertically down at any point on the top rail.
2. Handrail assemblies and guards shall be designed to resist a load of 50 pounds per linear foot (0.73kN/m) applied in any direction at the top and to transfer this load through the supports of the structure.
3. Infill area of guardrail system capable of withstanding a horizontal concentrated load of 200 pounds (90719 g) applied to one square foot (8165 g/sm) at any point in the system. Load not to act concurrently with loads on top rail of system in determining stress on guardrail.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
4. Required clearances.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.7 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

1.8 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

PART 2 - PRODUCTS

2.1 METAL MATERIALS

A. Aluminum Extrusions and Tubes: ASTM B 221 (ASTM B 221M), manufacturer's standard alloy and temper for type of use, finished to match assembly where used, otherwise mill finished.

2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Polyisocyanurate Board Insulation: ASTM C 1289, thickness as indicated.

C. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

D. Underlayment:

1. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
2. Polyethylene Sheet: 6-mil-(0.15-mm-)thick polyethylene sheet complying with ASTM D 4397.
3. Slip Sheet: Building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum, rosin sized.

E. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

F. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

G. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane or silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

H. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.3 ROOF HATCH – SLOPED ROOF

A. Roof Hatches: Metal roof-hatch units with lids and insulated curbs, welded and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, and integrally formed deck-mounting flange at perimeter bottom.

1. Basis-of-Design: Subject to compliance with requirements, provide Bilco SS-50TB single door, thermally broken aluminum equipment hatch with fully enclosed curb, or comparable product by one of the following:

a. Babcock-Davis
b. J.L. Industries, Inc.
c. Milcor, Inc.; Commercial Products Group of Hart & Cooley, Inc.

B. Type and Size: Single-leaf lid, 4’-0” x 5’’-0” minimum clear opening; coordinate quantity and size with roof plan.

C. Loads: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 20-lbf/sq. ft. (0.95-kPa) internal uplift load.

D. Finish: Kynar; color to be selected by Architect.

E. Construction:

1. Insulation: Polyisocyanurate board.
2. Hatch Lid: Opaque, 1” fiberglass with manufacturer's standard metal liner of same material and finish as outer metal lid.
3. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
4. Fabricate curbs to minimum height of 12 inches (300 mm) above roof, sloped to match roof plane.
5. Hinges: Type 316 stainless steel tamper-proof hinge contained within hatch as part of spring assembly.
6. Latch: Type 304 stainless steel slam latch with turn handle and inside/outside padlock hasps.
7. Springs: Greased heavy-duty compression springs in telescoping tubes.

F. Hardware: Stainless-steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.

1. Mortise Lock: Provide keyed high security option that allows the hatch to receive a mortise cylinder operated dead bolt.

2.4 ROOF HATCH – FLAT ROOF

A. Roof Hatches: Metal roof-hatch units with lids and insulated curbs, welded and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, and integrally formed deck-mounting flange at perimeter bottom.

1. Basis-of-Design: Subject to compliance with requirements, provide Bilco GSS single glass door, thermally broken aluminum equipment hatch with curb, or comparable product by one of the following:

a. Babcock-Davis

b. J.L. Industries, Inc.
c. Milcor, Inc.; Commercial Products Group of Hart & Cooley, Inc.

B. Type and Size: Single-leaf lid, match existing clear opening; coordinate quantity and size with roof plan.

C. Loads: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 20-lbf/sq. ft. (0.95-kPa) internal uplift load.

D. Finish: Kynar; color to be selected by Architect.

E. Construction:

1. Insulation: Polyisocyanurate board.
2. Hatch Lid: Aluminum extrusion with built-in condensation drainage channel and clear polycarbonate dome. Dome is coated for UV-resistance..
3. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
4. Fabricate curbs to minimum height of 12 inches (300 mm) above roof, sloped to match roof plane.
5. Hinges: Type 316 stainless steel tamper-proof hinge contained within hatch as part of spring assembly.
6. Latch: Type 304 stainless steel slam latch with turn handle and inside/outside padlock hasps.
7. Springs: Greased heavy-duty compression springs in telescoping tubes.

F. Hardware: Stainless-steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.

1. Mortise Lock: Provide keyed high security option that allows the hatch to receive a mortise cylinder operated dead bolt.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.

4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum or stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene sheet.
3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Roof-Hatch Installation:

1. Install roof hatch so top surface of hatch curb is parallel to roof plane.
2. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.

D. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.

B. Clean exposed surfaces according to manufacturer's written instructions.

C. Clean off excess sealants.

D. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 72 00

SECTION 07 81 00 - APPLIED FIRE PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sprayed fire-resistive materials.

B. Related Requirements:

1. Section 07 21 29 "Spray Acoustical Insulation" for acoustic spray applied over spray fire protection. Materials must be compatible and maintain fire rating.

1.3 DEFINITIONS

A. SFRM: Sprayed fire-resistive materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Sprayed fire-resistive material.
2. Substrate primers.
3. Bonding agent.
4. Metal lath.
5. Reinforcing fabric.
6. Reinforcing mesh.
7. Sealer.
8. Topcoat.

B. Shop Drawings: Framing plans or schedules, or both, indicating the following:

1. Extent of fire protection for each construction and fire-resistance rating.
2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
3. Minimum sprayed fire-resistive material thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
4. Treatment of sprayed fire-resistive material after application.

C. Samples: For each exposed product and for each color and texture specified, 4 inches (102 mm) square in size.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Product Certificates: For each type of sprayed fire-resistive material.

C. Evaluation Reports: For sprayed fire-resistive material, from ICC-ES.

D. Preconstruction Test Reports: For fire protection.

E. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by sprayed fire-resistive material manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects to set quality standards for materials and execution and for preconstruction testing.

1. Build mockup of each type of fire protection and different substrate and each required finish as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on field mockups of fire protection.

1. Field Mockup: .
2. Provide test specimens and assemblies representative of proposed materials and construction.

B. Preconstruction Adhesion and Compatibility Testing: Test for compliance with requirements for specified performance and test methods.

1. Bond Strength: Test for cohesive and adhesive strength according to ASTM E736. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
2. Density: Test for density according to ASTM E605. Provide density indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
3. Verify that manufacturer, through its own laboratory testing or field experience, attests that primers or coatings are compatible with sprayed fire-resistive material.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, obtain sprayed fire-resistive material manufacturer's written instructions for corrective measures including the use of specially formulated bonding agents or primers.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fire protection when ambient or substrate temperature is 44 deg F (7 deg C) or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fire protection, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fire protection dries thoroughly.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide fire protection, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.

B. Source Limitations: Obtain fire protection for each fire-resistance design from single source.

C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E119 or UL 263 ; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

D. Asbestos: Provide products containing no detectable asbestos.

2.2 SPRAYED FIRE-RESISTIVE MATERIALS

A. Sprayed Fire-Resistive Material : Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application .

1. Basis-of-Design Product: Subject to compliance with requirements, provide Isolatek International, CAFCO Fedolite M-II Isolatek Type M-II; GCP Advanced Technologies Construction Products, Monokote Z-146 series; or comparable product by one of the following:

a. Carboline Company, subsidiary of RPM International
b. GCP Applied Technologies Inc.
c. Isolatek International.
d. Southwest Fireproofing Products Co.

2. Application: Designated for exterior use by a qualified testing agency acceptable to authorities having jurisdiction.
3. Bond Strength: Minimum 1000-lbf/sq. ft. (47.9-kPa) cohesive and adhesive strength based on field testing according to ASTM E736.
4. Density: Not less than density specified in the approved fire-resistance design, according to ASTM E605.
5. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E605, whichever is thicker, but not less than 0.375 inch (9 mm).
6. Combustion Characteristics: ASTM E136.
7. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 0.
b. Smoke-Developed Index: 0.

8. Compressive Strength: Minimum 500 lbf/sq. in. (3447 kPa) according to ASTM E761.
9. Corrosion Resistance: No evidence of corrosion according to ASTM E937.
10. Deflection: No cracking, spalling, or delamination according to ASTM E759.
11. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E760.
12. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. (0.270 g/sq. m) in 24 hours according to ASTM E859.
13. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G21 or rating of 10 according to ASTM D3274 when tested according to ASTM D3273.

2.3 AUXILIARY MATERIALS

A. Provide auxiliary materials that are compatible with sprayed fire-resistive material and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved by sprayed fire-resistive material manufacturer and complying with one or both of the following requirements:

1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Primer's bond strength in required fire-resistance design complies with specified bond strength for sprayed fire-resistive material and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests according to ASTM E736.

C. Bonding Agent: Product approved by sprayed fire-resistive material manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.

D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required, according to fire-resistance designs indicated and sprayed fire-resistive material manufacturer's written instructions. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive sprayed fire-resistive material.

E. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by sprayed fire-resistive material manufacturer.

F. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by sprayed fire-resistive material manufacturer. Include pins and attachment.

G. Sealer: Transparent-drying, water-dispersible, tinted protective coating recommended in writing by sprayed fire-resistive material manufacturer for each fire-resistance design.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Isolatek International.

H. Topcoat: Suitable for application over sprayed fire-resistive material; of type recommended in writing by sprayed fire-resistive material manufacturer for each fire-resistance design.

1. Water-Based Permeable Topcoat: Factory-mixed formulation for brush, roller, or spray application over applied SFRM. Provide application at a rate of 60 sq. ft./gal. (1.5 sq. m/L) .

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Isolatek International.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design.

1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fire protection with substrates under conditions of normal use or fire exposure.
2. Verify that objects penetrating fire protection, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
3. Verify that substrates receiving fire protection are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fire protection application.

B. Verify that concrete work on steel deck is complete before beginning Work.

C. Verify that roof construction, installation of rooftop HVAC equipment, and other related work are complete before beginning Work.

D. Conduct tests according to sprayed fire-resistive material manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.

E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fire protection materials during application.

B. Clean substrates of substances that could impair bond of fire protection.

C. Prime substrates where included in fire-resistance design and where recommended in writing by sprayed fire-resistive material manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fire protection.

D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fire protection. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

A. Construct fire protection assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fire protection Work.

B. Comply with sprayed fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fire protection; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fire protection with other construction to minimize need to cut or remove fire protection.

1. Do not begin applying fire protection until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
2. Defer installing ducts, piping, and other items that would interfere with applying fire protection until application of fire protection is completed.

D. Metal Decks:

1. Do not apply fire protection to underside of metal deck substrates until concrete topping, if any, is completed.
2. Do not apply fire protection to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fire protection.

E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and sprayed fire-resistive material manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by sprayed fire-resistive material manufacturer.

F. Spray apply fire protection to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by sprayed fire-resistive material manufacturer.

G. Extend fire protection in full thickness over entire area of each substrate to be protected.

H. Install body of fire protection in a single course unless otherwise recommended in writing by sprayed fire-resistive material manufacturer.

I. Where sealers are used, apply products that are tinted to differentiate them from fire protection over which they are applied.

J. Provide a uniform finish complying with description indicated for each type of fire protection material and matching finish approved for required mockups.

K. Cure fire protection according to sprayed fire-resistive material manufacturer's written instructions.

L. Do not install enclosing or concealing construction until after fire protection has been applied, inspected, and tested and corrections have been made to deficient applications.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Test and inspect as required by the IBC , Subsection 1705.13, "Sprayed Fire-Resistant Materials.", as indicated on Schedule of Special Inspections.

B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fire protection for the next area until test results for previously completed applications of fire protection show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

C. Fire protection will be considered defective if it does not pass tests and inspections.

1. Remove and replace fire protection that does not pass tests and inspections, and retest.
2. Apply additional fire protection, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

D. Prepare test and inspection reports.

3.5 CLEANING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

3.6 PROTECTION

A. Protect fire protection, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fire protection is without damage or deterioration at time of Substantial Completion.

3.7 REPAIRS

A. As installation of other construction proceeds, inspect fire protection and repair damaged areas and fire protection removed due to work of other trades.

B. Repair fire protection damaged by other work before concealing it with other construction.

C. Repair fire protection by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 07 81 00

SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Penetration firestopping systems for the following applications:

a. Penetrations in fire-resistance-rated walls.

B. Related Requirements:

1. Section 07 81 00 “Applied Fire Protection” for sprayed fire-resistive materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approval according to FM Approval 4991, "Approval Standard for Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."
3) FM Approval in its "Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Fire Protection Products.
b. A/D Fire Protection Systems Inc.
c. Hilti, Inc.
d. RectorSeal Firestop; a CSW Industrials Company.
e. STC Sound Control.
f. Tremco Incorporated.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.

D. Manufactured Piping Penetration Firestopping System: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ProVent Systems.
   b. RectorSeal Firestop; a CSW Industrials Company.

2. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
3. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
4. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
5. Sleeve: Molded-PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
6. Stack Fitting: ASTM A48/A48M, gray-iron, hubless-pattern wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
7. Special Coating: Corrosion resistant on interior of fittings.

E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.3 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Listed Building Products" under "Firestop Systems."

C. Where FM Approval-approved systems are indicated, they refer to design numbers listed in FM Approval's "Approval Guide" under "Wall and Floor Penetration Fire Stops."

D. Each contractor shall be responsible for selecting all systems required for their scope of work. Each contractor shall confirm all systems with the local code official.

END OF SECTION 07 84 13

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.
4. Solvent-release-curing joint sealants.
5. Preformed joint sealants.
6. Acoustical joint sealants.

B. Related Sections:

1. Section 04 20 00 "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
2. Section 08 80 00 "Glazing" for glazing sealants.
3. Section 09 29 00 "Gypsum Board" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
4. Section 09 30 00 "Tiling" for sealing tile joints.

1.3 PERFORMANCE REQUIREMENTS

1. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

2. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.

D. Preconstruction Field Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.

E. Field Test Report Log: For each elastomeric sealant application.

F. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty periods.

1. Warranty Period:
   a. 5 years from date of Substantial Completion for polyurethane sealant.
   b. 20 years from date of Substantial Completion for silicone sealant.

B. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants Primers: Provide sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
1. Sealant Primers for Nonporous Substrates: 250 g/L.
2. Sealant Primers for Porous Substrates: 775 g/L.
3. Other: 750 g/L.

C. VOC Content of Interior Sealants: Provide sealant for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
1. Architectural Sealants: 250 g/L.

2. Sealant for Porous Substrates: 50 g/L.
3. Metal to Metal: 50 g/L.
4. Wood: 30 g/L.
5. Plastic Foams: 50 g/L.
6. Other: 420 g/L.

D. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range of colors, unless otherwise indicated.
1. Provide custom color sealant for joints in face brick to match color of face brick.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Immersion in Liquids. Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247 and qualify for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.

D. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

E. Single-Component Neutral- and Basic-Curing Silicone Sealant ES-1:
1. Products:
   a. Dow Corning Corporation; 790.
   b. GE Silicones; SilPruf LM SCS2700.
   c. Tremco; Spectrem 1.
2. Type and Grade: S (single component) and NS (non-sag).
3. Class: 50.
4. Use Related to Exposure: NT (non-traffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
6. Use O Joint Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, ceramic tile and wood.
7. Stain-Test-Response Characteristics: Non-staining to porous substrates per ASTM C 1248.
8. High-performance coating, galvanized steel and ceramic tile.

F. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant or Single-Component Mildew-Resistant Acid-Curing Silicone Sealant ES-2:
1. Products:
   a. Dow Corning Corporation; 786 Mildew Resistant.
   b. GE Silicones; Sanitary SCS1700.
   c. Pecora Corporation; 898.
   d. Tremco; Tremsil 600 White.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
6. Use O Joint Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel and ceramic tile.

G. Multicomponent Non-sag Urethane Sealant ES-3:
1. Products:
   a. Pecora Corporation; Dynatrol II.
   b. Tremco; Dymeric 240/240FC.
   c. Tremco; Vulkem 922.

2. Type and Grade: M (multicomponent) and NS (non-sag).
3. Class: 50.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.
6. Use O Joint Substrates: Ceramic tile and wood.

H. Multicomponent Non-sag Urethane Sealant ES-4:
1. Products:
   a. Pecora Corporation; Dynatred.
   b. Sika Corporation, Inc.; Sikaflex - 2c NS TG.
   c. Sonneborn, Division of ChemRex Inc.; NP 2.
   d. Tremco; Vulkem 227.
   e. Tremco; Vulkem 322 DS.
2. Type and Grade: M (multicomponent) and NS (non-sag).
3. Class: 25.
4. Uses Related to Exposure: T (traffic).
5. Uses Related to Joint Substrates: M and as applicable to joint substrates indicated, O.
   a. Use O Joint Substrates: Ceramic tile.

I. Multicomponent Pourable Urethane Sealant ES-5:
1. Products:
   a. Pecora Corporation; Urexpan NR-200.
   b. Tremco; THC-901.
   c. Tremco; THC-900.
   d. Tremco; Vulkem 245.
   e. Pecora Corporation; Urexpan NR 300, Type H.
   f. Pecora Corporation; Urexpan NR 300, Type M.
   g. Sika Corporation, Inc.; Sikaflex - 2c SL.
   h. Sonneborn, Division of ChemRex Inc.; SL 2.
2. Type and Grade: M (multicomponent) and P (pourable).
3. Class: 25.
4. Use Related to Exposure: T (traffic).
5. Uses Related to Joint Substrates: M.

2.4 SOLVENT-RELEASE JOINT SEALANTS

A. Butyl-Rubber-Based Solvent-Release Joint Sealant SRS-1: Comply with ASTM C 1085.
1. Bostik Findley; Bostik 300.
2. Pecora Corporation; BC-158.
3. Sonneborn, Division of ChemRex Inc.; Sonneborn Multi-Purpose Sealant.
4. Tremco; Tremco Butyl Sealant.

2.5 LATEX JOINT SEALANTS

A. Latex Sealant LS-1: Comply with ASTM C 834, Type P, Grade NF.
1. Bostik Findley; Chem-Calk 600.
2. Pecora Corporation; AC-20+.
3. Sonneborn, Division of ChemRex Inc.; Sonolac.
4. Tremco; Tremflex 834.

2.6 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints AS-1: Manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C 834 and the following:
1. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
2. Products:
   a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
   b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

B. Acoustical Sealant for Concealed Joints AS-2: Manufacturer's standard, nondrying, non-hardening, non-skinning, non-staining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.
   1. Pecora Corporation; BA-98.
   2. Tremco; Tremco Acoustical Sealant.

2.7 PREFORMED JOINT SEALANTS

A. Preformed Foam Sealant PS-1:
   1. Manufacturer's standard preformed, precompressed, open-cell foam sealant that is manufactured from high-density urethane foam impregnated with a nondrying, water-repellent agent; is factory produced in precompressed sizes in roll or stick form to fit joint widths indicated; is coated on one side with a pressure-sensitive adhesive and covered with protective wrapping; develops a watertight and airtight seal when compressed to the degree specified by manufacturer; EMSEAL Joint Systems, Ltd.; Backerseal.
   2. Properties: Permanently elastic, mildew resistant, non-migratory, non-staining, and compatible with joint substrates and other joint sealants. Manufacturer's standard density.

2.8 LOW PRESSURE EXPANDING FOAM

A. Low Pressure Expanding Foam LPEF-1: Polyurethane foam sealant develops an air-tight seal.
   1. Dow Chemical Company; Great Stuff Window and Door Foam.
   2. Fomo Products, Inc; Handi-Seal Window and Door Sealant.

B. Low Pressure Expanding Foam LPEF-2: Polyurethane foam sealant develops an air-tight seal.
   1. Dow Chemical Company; Great Stuff Pro Gaps & Cracks.
   2. Fomo Products, Inc; Handi-Foam Spray Foams.

2.9 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.10 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.
    c. Stone
    d. Unglazed surfaces of ceramic tile.
    e. Exterior finish systems.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.

2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

H. Installation of Preformed Silicone-Sealant System: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application JS-1: Exterior horizontal traffic, isolation and contraction joints in cast-in-place concrete slabs; ES-5.

B. Joint-Sealant Application JS-2: Exterior vertical and horizontal nontraffic joints between masonry; ES-2

C. Joint-Sealant Application JS-3: Exterior vertical control and expansion joints in unit masonry.
1. Joint Sealant: ES-4.

D. Joint-Sealant Application JS-4: Exterior non-traffic vertical joints between different materials listed above and exterior non-traffic joints between dissimilar materials where the joining of the two surfaces leaves a gap between the meeting materials or components as may be dictated by the various methods of construction to make watertight.
1. Joint Sealant: ES-3, unless otherwise noted.

E. Joint-Sealant Application JS-5: Exterior perimeter joints of door, window and louver frames; ES-1.

F. Joint-Sealant Application JS-6: Exterior control and expansion joints in horizontal traffic surfaces of concrete slabs and other paving materials; ES-5.

G. Joint-Sealant Application JS-7: Interior perimeter joints of exterior openings; ES-2.

H. Joint-Sealant Application JS-8: Perimeter joints between interior wall surfaces and frames of interior doors and windows; LS-1.

I. Joint-Sealant Application JS-9: Joints of casework and millwork to walls except in sanitary conditions specified above; LS-1.

J. Joint-Sealant Application JS-10: Interior control, expansion, and isolation joints in concrete slabs.
   1. Joint Sealant: ES-5.

K. Joint-Sealant Application JS-11: Under aluminum thresholds; SRS-1.

L. Joint-Sealant Application JS-12: Joints in STC rated walls; AS-1 or AS-2. Provide AS-1 at exposed sealant locations.

M. Joint-Sealant Application JS-13: Gaps at exterior joints not previously indicated in Joint Sealant Schedule between dissimilar materials where the joining of the two surfaces leaves a gap between the meeting materials or components.
   1. Joint Sealant: ES-4.

N. Joint-Sealant Application JS-14: Gaps at interior joints not previously indicated in Joint Sealant Schedule between dissimilar materials where the joining of the two surfaces leaves a gap between the meeting materials or components.
   1. Joint Sealant: ES-2.

O. Joint-Sealant Application JS-15: Joint between window and door frames and wall framing/CMU; LPEF-1.

P. Joint-Sealant Application JS-16: Gaps in stud wall framing not filled with insulation, voids/spaces between studs at corner stud wall framing, around penetrations through exterior sheathing and for setting bed in sill pan flashing; LPEF-2.

END OF SECTION 07 92 00

SECTION 08 03 52 - HISTORIC TREATMENT OF WOOD WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The Work of This Section Includes: Historic treatment of wood windows in the form of the following:

1. Repairing wood windows.
2. Replacing weather stripping.
3. Reglazing.

B. Related Requirements:

1. Section 01 35 91 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 08 52 00 "Wood Windows" for new wood windows or sash.

1.3 DEFINITIONS

A. Design Reference Sample: A sample that represents Architect's prebid selection of work to be matched; it may be existing work or work specially produced for Project.

B. Glazing: Includes glass, glazing points, glazing tapes, glazing sealants, and glazing compounds.

C. Window: Includes window frame, sash, trim, and hardware unless otherwise indicated by context.

D. Window Unit: Includes window, insect screen and associated hardware and accessories, unless otherwise indicated by context.

E. Window Component Terminology: Wood window components for historic treatment work include the following classifications:

1. Frame Components: Head, jambs, and sill.
2. Sash Components: Stiles and rails, parting bead, stop, and muntins.
3. Exterior Trim: Exterior casing, brick mold, and cornice or drip cap.
4. Interior Trim: Casing, stool, and apron.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of wood windows.
2. Review methods and procedures related to historic treatment of wood windows including, but not limited to, the following:

    a. Historic treatment specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
    b. Materials, salvage materials, material application, sequencing, tolerances, and required clearances.
    c. Fire-protection plan.
    d. Wood window historic treatment program.

1.5 SEQUENCING AND SCHEDULING

A. Perform historic treatment of wood windows in the following sequence, which includes Work specified in this and other Sections:

1. Label each window frame with permanent opening-identification number in inconspicuous location.
2. Tag existing window sash, trim, and insect screens with opening-identification numbers and remove for on-site or off-site repair. Indicate on tags the locations on window of each component.
3. Remove window, dismantle hardware, and tag hardware with opening-identification numbers.
4. Install temporary protection and security at window openings.
5. In the shop, label each sash, trim, and insect screen with permanent opening-identification number in inconspicuous location and remove site-applied tags.
6. Sort units by condition, separating those that need extensive repair.
7. Clean surfaces.
8. General Wood-Repair Sequence:

    a. Remove paint to bare wood.
    b. Rack frames slightly to inject adhesive into mortise and tenon joints; square frames to proper fit before adhesive sets.
    c. If thicker than original glass is required, rout existing muntins to required rebate size.
    d. Repair wood by consolidation, member replacement, partial member replacement, and patching.
    e. Sand, prime, fill, sand again, and prime surfaces again for refinishing.

9. Repair, refinish, and replace hardware if required. Reinstall operating hardware.
10. Replace torn insect screening and repair broken screen frames and hardware.
11. Install glazing.
12. Remove temporary protection and security at window openings.
13. Reinstall units.
14. Apply finish coats.
15. Install remaining hardware and weather stripping.
16. Install insect screens on windows.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for product application and use.
2. Include test data substantiating that products comply with requirements.

B. Shop Drawings:

1. Include plans, elevations, and sections with field verified dimensions, showing locations and extent of repair, replacement, and new work. Include enlarged details with complete dimensions of replacement components; indicate materials, profiles, joinery, reinforcing, method of splicing into or attaching to existing wood window unit, accessory items, and finishes.
2. Include schedule of window unit repairs, using same reference number for openings as those on Contract Drawings.
3. Include details of temporary protection and security at window openings.
4. Include templates for installation of hardware and anchorages.
5. Include provisions for sealant joints and flashing as required for location.

C. Samples for Initial Selection: For each type of exposed wood and finish.

1. Identify wood species, cut, and other features.
2. Include Samples of hardware and accessories involving color selection.

D. Samples for Verification: Actual sample of finished products for the following, in manufacturer's standard sizes unless otherwise indicated:

1. Repaired Wood Window Unit Members: Prepare Samples using existing wood window members removed from site, repaired, and prepared for refinishing.
2. Refinished Wood Window Unit Members: Prepare Samples using existing wood window members removed from site, repaired, and refinished.
3. Weather Stripping: 12-inch- long sections.

1.7 INFORMATIONAL SUBMITTALS

A. Preconstruction Test Reports: For historic treatment of wood windows.

B. Qualification Statements: For historic treatment specialist and wood-repair-material manufacturer.

C. Wood Window Historic Treatment Program: Submit before the Work begins.

1.8 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic wood window specialist, experienced in repairing, refinishing, and replacing wood window units in whole and in part. Experience only in fabricating and installing new wood windows is insufficient experience for wood-window historic treatment work.

B. Wood-Repair-Material Manufacturer Qualifications: A firm regularly engaged in producing wood consolidant and wood-patching compound that have been used for similar historic wood-treatment applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection and on-site assistance.

C. Wood Window Historic Treatment Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for historic treatment work, including protection of surrounding materials and Project site.

1.9 MOCKUPS

A. Prepare mockups of historic treatment repair to demonstrate aesthetic effects, to set quality standards for materials and execution, and to set quality standards for fabrication and installation. Prepare mockups so they are inconspicuous.

1. Locate mockups in locations that enable viewing under same conditions as the completed Work.
2. Wood Window Repair: Prepare one entire window to serve as mockup to demonstrate samples of each type of repair of wood window members including frame, sash, glazing, and hardware. Demonstrate operable windows will operate as intended after repair.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Pack, deliver, and store products in suitable packs, heavy-duty cartons, or wooden crates; surround with sufficient packing material to ensure that products are not deformed, broken, or otherwise damaged.

B. Store products inside a well-ventilated area, protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity, and where environmental conditions comply with manufacturer's requirements.

1.11 FIELD CONDITIONS

A. Weather Limitations: Proceed with historic treatment of wood windows only when existing and forecasted weather conditions are within the environmental limits set by each manufacturer's written instructions and specified requirements.

PART 2 - PRODUCTS

2.1 HISTORIC TREATMENT OF WOOD WINDOWS QUALITY STANDARD

A. Quality Standard: Comply with applicable requirements in NAAWS 4.0 Section 12, "Historic Restoration Work", and AWI 0601 for construction, materials, finishes, and other requirements, unless otherwise indicated and except for practices cited that delegate Contractor's repair work to specific trades.

2.2 REPLACEMENT INSECT SCREENS

A. Replacement Wood Insect-Screen Frames: Replicated wood insect-screen frame custom fabricated from salvaged, sound, original wood, new wood, or a combination thereof; tight fitting and removable, with a minimum of exposed fasteners and latches.

1. Joint Construction: Joints matching existing
2. Wood Species: Match wood species of existing insect screen
3. Wood Cut: Match cut of existing insect screen.
4. Insect-Screen Members: Replicate existing insect screen members.

B. Screening: match existing

2.3 WOOD-REPAIR MATERIALS

A. Source Limitations: Obtain wood consolidant and wood-patching compound from single source from single manufacturer.

B. Wood Consolidant: Ready-to-use product designed to penetrate, consolidate, and strengthen soft fibers of wood materials that have deteriorated due to weathering and decay and designed specifically to enhance the bond of wood-patching compound to existing wood.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Marvin Windows
b. Abatron, Inc
c. ConServ Epoxy LLC
d. Protective Coating Company
e. System Three Resins, Inc.

C. Wood-Patching Compound: Two-part epoxy-resin wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound designed for filling voids in damaged wood materials that have deteriorated due to weathering and decay. Compound capable of filling deep holes and spreading to feather edge.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Marvin Windows
b. Abatron, Inc
c. ConServ Epoxy LLC
d. Protective Coating Company
e. System Three Resins, Inc.

2.4 GLAZING MATERIALS

A. Primary Window Glazing:

1. Glass:

a. See Section 088000 "Glazing."

2.5 REPLACEMENT WEATHER STRIPPING

A. Replacement Compression-Type Weather Stripping: Compressible weather stripping designed for permanently resilient sealing under bumper or wiper action; completely concealed when window is closed.

1. Weather-Stripping Material: Match existing materials and profiles as much as possible unless otherwise indicated.

a. Cellular Elastomeric Gaskets: Preformed; complying with ASTM C509.
b. Dense Elastomeric Gaskets: Preformed; complying with ASTM C864.

B. Replacement Sliding-Type Weather Stripping: Woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric.

1. Weather Seals: Provide weather stripping with integral barrier fin or fins of semirigid, polypropylene sheet or polypropylene-coated material.

C. Replacement Metal Weather Stripping: [Bronze][Zinc]<Insert metal> weather stripping; designed either as one piece to seal by sliding into a groove in the sash or as two pieces that interlock; and completely concealed when window is closed.

2.6 MISCELLANEOUS MATERIALS

A. Borate Preservative Treatment: Inorganic, borate-based solution, with disodium octaborate tetrahydrate as the primary ingredient; manufactured for preserving weathered and decayed wood from further damage by decay fungi and wood-boring insects; containing no boric acid.

B. Cleaning Materials:

1. Detergent Solution: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 1/2 cup of laundry detergent that contains no ammonia, 5 quarts of 5 percent sodium hypochlorite bleach, and 15 quarts of warm water for each 5 gal. of solution required.
2. Mildewcide: Commercial, proprietary mildewcide or a solution prepared by mixing 1/3 cup of household detergent that contains no ammonia, 1 quart of 5 percent sodium hypochlorite bleach, and 3 quarts of warm water.

C. Adhesives: Wood adhesives with minimum 15- to 45-minute cure at 70 deg F, in gunnable and liquid formulations as recommended in writing by adhesive manufacturer for each type of repair and exposure condition.

D. Fasteners: Use fastener metals that are noncorrosive and compatible with each material joined.

1. Match existing fasteners in material and type of fastener unless otherwise indicated.
2. Use concealed fasteners for interconnecting wood components.
3. Use concealed fasteners for attaching items to other work unless exposed fasteners are unavoidable or the existing fastening method.
4. For fastening metals, use fasteners of same basic metal as fastened metal unless otherwise indicated.
5. For exposed fasteners, use Phillips-type machine screws of head profile flush with metal surface unless otherwise indicated.
6. Finish exposed fasteners to match finish of metal fastened unless otherwise indicated.

E. Anchors, Clips, and Accessories: Fabricate anchors, clips, and window accessories of aluminum, nonmagnetic stainless steel, or hot-dip zinc-coated steel complying with requirements in ASTM B633 for SC 3 (Severe) service condition.

F. Joint Sealants and Backings: Provide joint sealants, backings, and other related materials in accordance with Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT SPECIALIST

A. Historic Treatment Specialist Firms: Subject to compliance with requirements..

3.2 HISTORIC TREATMENT OF WOOD WINDOW UNITS, GENERAL

A. Historic Treatment Appearance Standard: Completed work is to have a uniform appearance as viewed by Architect from the window interior at 5 ft. away and from the window exterior at 20 ft. away.

B. General: In treating historic items, disturb them as minimally as possible and as follows:

1. Stabilize and repair wood window units to maintain and reestablish structural integrity and weather resistance while maintaining the existing form of each item.
2. Repair items in place where possible unless otherwise indicated.
3. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use only the gentlest mechanical methods, such as scraping and natural-fiber bristle brushing, that will not abrade wood substrate, reducing clarity of detail. Do not use abrasive methods such as sanding, wire brushing, or power tools except as indicated as part of the historic treatment program and as approved by Architect.

C. Identify removed window units with numbering system corresponding to window locations to ensure reinstallation in same location. Key window units to Drawings indicating location of each removed unit. Permanently label units in a location that will be concealed after reinstallation.

3.3 EXAMINATION

A. Examine areas and conditions, with historic treatment specialist present, for compliance with requirements for environmental conditions, and other conditions affecting performance of the Work.

1. If existing wood window units cannot be prepared to an acceptable condition for repair, notify Architect in writing.
2. Notify Architect of undocumented detrimental conditions, including rotted wood and other deteriorated items.

B. Begin historic treatment of wood windows only after unsatisfactory conditions have been corrected.

3.4 PREPARATION

A. Protect adjacent materials from damage by historic treatment of wood window units.

B. Protection of Openings: Where sash or windows are indicated for removal, cover resultant openings with temporary enclosures so that openings are weathertight during repair period.

C. Install temporary protective measures to protect wood window unit work that is indicated to be completed later.

D. Clean wood window units of mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. After cleaning, rinse thoroughly with fresh water. Allow to dry before repairing or painting.

E. Remove coatings and apply borate preservative treatment before repair.

3.5 WOOD WINDOW UNIT REPAIR, GENERAL

A. Repair and Refinish Existing Hardware: Dismantle window hardware; strip paint, repair, and refinish it to match finish samples; lubricate moving parts just enough to function smoothly.

B. Repair Wood Window Units: Replicate existing, retaining as much original material as possible to perform repairs.

1. Unless otherwise indicated, repair wood window units by consolidating, patching, splicing, or otherwise reinforcing wood with new wood matching existing wood or with salvaged, sound, original wood.
2. Where indicated, repair wood window units by limited replacement matching existing material.
3. Sash Balance: Repair sash balances to function in accordance with type as specified in "Hardware" Article above. Provide missing sash balances.

C. Glazing: Where indicated, reglaze window units removed for repair, before reinstallation.

1. Mill new and rout existing glazed members to accommodate new glass thickness.
2. Provide replacement glazing stops coordinated with glazing system indicated.
3. Provide glazing stops to match contour of sash frames.

D. Reinstall window units removed for repair into original openings.

E. Weather Stripping: Replace nonfunctioning and install missing weather stripping to ensure full-perimeter and meeting rail weather stripping for each operable sash.

3.6 WOOD WINDOW UNIT, PATCH-TYPE REPAIR

A. General: Patch wood members that exhibit depressions, holes, or similar voids, and that have limited amounts of rotted or decayed wood.

1. Remove sash and insect screen from frame before performing patch-type repairs at meeting or sliding surfaces unless otherwise indicated.
2. Verify that surfaces are sufficiently clean and free of paint and other residue before patching.

B. Treat wood members with wood consolidant before applying patching compound. Coat wood surfaces by brushing, applying multiple coats until wood is saturated and unable to absorb more. Allow treatment to harden before filling void with patching compound.

C. Remove rotted or decayed wood down to sound wood.

D. Apply borate preservative treatment to accessible surfaces after removing rotted or decayed wood and before applying wood consolidant or patching compound. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom. Allow treatment to dry.

E. Apply wood-patching compound to fill depressions, nicks, cracks, and other voids created by removed or missing wood.

1. Prime patch area with application of wood consolidant or manufacturer's recommended primer.
2. Mix only as much patching compound as can be applied in accordance with manufacturer's written instructions.
3. Apply patching compound in layers as recommended in writing by manufacturer until the void is completely filled.
4. Sand patch surface smooth and flush with adjacent wood, without voids in patch material, and matching contour of wood member.
5. Clean spilled compound from adjacent materials immediately.

3.7 REGLAZING

A. Comply with combined written instructions of manufacturers of glass, glazing systems, and glazing materials, unless more stringent requirements are indicated.

B. Remove cracked and damaged glass and glazing materials from openings and prepare surfaces for reglazing.

C. Remove existing glass and glazing where indicated on Drawings and prepare surfaces for reglazing.

D. Remove glass and glazing from openings and prepare surfaces for reglazing.

E. Size glass as required by Project conditions to provide necessary bite on glass and minimum edge and face clearances, with reasonable tolerances.

F. Apply primers to joint surfaces where required for adhesion of glazing system, as determined by preconstruction testing.

G. Install setting bead, side beads, and back bead against stop in glazing rabbets before setting glass.

H. Install glass with proper orientation so that coatings, if any, face exterior or interior as required.

I. Install glazing points as required for glazing system.

J. Disposal of Removed Glass: Remove from Owner's property and legally dispose of unless otherwise indicated.

3.8 INSTALLATION, GENERAL

A. Condition replacement wood members and replacement units to prevailing conditions at installation areas before installing.

3.9 INSTALLATION OF REPLACEMENT INSECT SCREENS

A. Install wood-framed, aluminum-framed, insect-screen where indicated.

1. Locate insect-screen frames on window interior or exterior to match existing unless otherwise indicated.
2. Install insect-screen frames by mounting to window or sash frame as indicated on Drawings and in accordance with manufacturer's written instructions.

B. Install insect screening to be smooth, flat, and uniformly taut.

C. Disposal of Removed Units: Remove from Owner's property and legally dispose of.

3.10 INSTALLATION OF REPLACEMENT WEATHER STRIPPING

A. Install weather stripping for tight seal between sash and frame as determined by preconstruction testing and demonstrated in mockup.

3.11 ADJUSTING

A. Adjust existing and replacement operating sash, insect screens, hardware, weather stripping, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

3.12 CLEANING

A. Clean exposed surfaces immediately after historic treatment of wood windows. Avoid damage to coatings and finishes. Remove excess sealants, glazing and patching materials, dirt, and other substances.

B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction.

3.13 PROTECTION

A. Protect window surfaces from contact with contaminating substances resulting from construction operations. Monitor window surfaces adjacent to and below exterior concrete and masonry during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances contact window surfaces, remove contaminants immediately.

END OF SECTION 08 03 52

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes hollow-metal work.

B. Related Requirements:

1. Section 08 71 00 "Door Hardware" for door hardware for hollow-metal doors.
2. Section 09 91 13 “Exterior Painting” and 09 91 23 “Interior Painting” for field painting hollow metal doors and frames.
3. Division 26 for electrical connections, including conduit and wiring for door controls and operators.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.7 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.10 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amweld International, LLC.
2. Ceco Door; AADG, Inc.; ASSA ABLOY
3. Curries Company; an Assa Abloy Group company.
4. Mesker Door Inc.
5. Republic Doors and Frames.

B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
3. Temperature-Rise Limit: At exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

4. Stairwell Doors shall have a 250°F. temperature rise rating, and the label on the door shall indicate the specific hourly fire rating.

B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.38 deg Btu/F x h x sq. ft. (2.16 W/K x sq. m) when tested according to ASTM C518.

2.3 INTERIOR DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3.

1. Physical Performance: Level A according to SDI A250.4.
2. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Metallic-coated, cold-rolled steel sheet, minimum thickness of 0.053 inch (1.3 mm).
d. Edge Construction: Model 2, Seamless.
e. Edge Bevel: Provide manufacturer’s standard beveled or square edges.
f. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated and temperature-rise-rated doors.

3. Frames:

a. Materials: Metallic-coated, steel sheet, minimum thickness of 0.053 inch (1.3 mm).
b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: Full profile welded.

4. Exposed Finish: Prime.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3.

1. Physical Performance: Level A according to SDI A250.4.
2. Doors:

a. Type: As inicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm.)
c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
d. Edge Construction: Model 2, Seamless.
e. Core: Manufacturer's standard polystyrene, polyurethane or polyisocyanurate core at manufacturer's discretion.

1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu (0.370 K x sq. m/W) 13 when tested according to ASTM C 1363.

3. Frames:

   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
   b. Construction: Full profile welded.

4. Exposed Finish: Prime.

2.5 BORROWED LITES

A. Fabricate of metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm).

B. Construction: Full profile welded.

C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.6 HOLLOW-METAL PANELS

A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

2.7 FRAME ANCHORS

A. Jamb Anchors:

   1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
   2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:

   1. At separate Topping Concrete Slabs: Provide adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.8 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

   1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

G. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

I. Glazing: Comply with requirements in Section 08 80 00 "Glazing."

J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.9 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:

1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
2. Fire Door Cores: As required to provide fire-protection ratings indicated.
3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches (3.2 mm in 51 mm).
4. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.
5. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
6. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
5. Jamb Anchors: Provide number and spacing of anchors as follows:

a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:

1) Two anchors per jamb up to 60 inches (1524 mm) high.
2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.

4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.

b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

1) Three anchors per jamb up to 60 inches (1524 mm) high.
2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.

c. Post-installed Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.

6. Head Anchors: Two anchors per head for frames more than 42 inches (1067 mm) wide and mounted in metal-stud partitions.
7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

a. The use of through-bolts to install surface applied hardware is not acceptable.

2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
3. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

a. Where electrified hardware is required on a door and frame, provide Electrolynx™ wiring harnesses in the door and around the frame which plug directly into the electric hardware and hinge. Harness must be factory installed. Provide the number of wires necessary as required by the specified hardware.

b. Provide 16 gauge cover boxes for all electronic hardware mortises in grouted hollow metal frames. This includes, but is not limited to, door contacts, electric strikes, electric hinges and pivots. Provide conduit from the lower cover boxes to the door contact junction box at the top of the frame. Spot weld guards to frame and secure conduit.

F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow-metal work.
5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.10 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.11 ACCESSORIES

A. Louvers: Provide louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.020-inch- (0.5-mm-) thick, cold-rolled steel sheet set into 0.032-inch- (0.8-mm-) thick steel frame.

1. Lightproof Louver: Stationary louvers constructed with baffles to prevent light from passing from one side to the other.
2. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same qualified testing and inspecting agency that established fire-resistance rating of door assembly.
3. Provide 6 each stationary and fire-rated automatic louvers for extra maintenance materials at end of project. Turn over to Owner in unopened cartons.

B. Mullions and Transom Bars:

1. Removable mullions.
2. Join to transom bars adjacent members by welding or rigid mechanical anchors

C. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

a. At fire-rated openings, install frames according to NFPA 80.
b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
c. Install frames with removable stops located on secure side of opening.
d. Install door silencers in frames before grouting.
e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
g. Field apply bituminous coating to backs of frames that will be filled with grout containing anti-freezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post installed expansion anchors.

a. Floor anchors may be set with power-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:

a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
c. At Bottom of Door: Refer to door schedule.
d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with hollow-metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08 11 13

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 08 80 00 "Glazing" for glass view panels in flush wood doors.

1.3 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction, louvers, and trim for openings. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

C. Samples for Initial Selection: For factory-finished doors.

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.
2. Corner sections of doors, approximately 8 by 10 inches (200 by 250 mm), with door faces and edges representing actual materials to be used.

   a. Provide Samples for each species of veneer and solid lumber required.
   b. Finish veneer-faced door Samples with same materials proposed for factory-finished doors.

3. Louver blade and frame sections, 6 inches (150 mm) long, for each material and finish specified.
4. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is a certified participant in AWI's Quality Certification Program.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

B. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during remainder of construction period.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Algoma Hardwoods, Inc.
2. Eggers Industries.
3. Graham Wood Doors; an Assa Abloy Group company.
4. Marshfield Door Systems, Inc.
5. Mohawk Doors; a Masonite company.
6. VT Industries, Inc.

B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

B. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that do not contain urea formaldehyde.

C. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

D. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
3. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
4. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
5. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

E. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.

F. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade LD-2, made with binder containing no urea-formaldehyde.
2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware:

a. 5-inch (125-mm) top-rail blocking, in doors indicated to have closers.
b. 5-inch (125-mm) bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
c. 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.

3. Provide doors with glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

G. Mineral-Core Doors:

1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.

a. 5-inch (125-mm) top-rail blocking.
b. 5-inch (125-mm) bottom-rail blocking, in doors indicated to have protection plates.
c. 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices.

3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

a. Screw-Holding Capability: 550 lbf (2440 N) per WDMA T.M.-10.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors:

1. Grade: Custom (Grade A faces).
2. Species: To match existing wood doors.
3. Cut: Plain sliced (flat sliced).
4. Match between Veneer Leaves: Book match.
5. Assembly of Veneer Leaves on Door Faces: Running match.
6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
7. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 20 feet (6 m) or more.
8. Transom Match: Continuous match.
9. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.
10. Exposed Vertical and Top Edges: Same species as faces - edge Type A.
11. Core: Particleboard.
12. Construction: Seven plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering.

2.4 LIGHT FRAMES AND LOUVERS

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Manufacturer's standard shape.
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

C. Wood Louvers: Door manufacturer's standard solid-wood louvers unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Provide 6 louvers for extra maintenance materials at end of project. Turn over to Owner at end of project.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

C. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.

1. Fabricate door and transom panels with full-width, solid-lumber, rabbeted, meeting rails. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.

D. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.

2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 80 00 "Glazing."
3. Louvers: Factory install louvers in prepared openings.

2.6 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Use only paints and coatings that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Transparent Finish:

1. Grade: Custom.
2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" System 5, conversion varnish.
3. Staining: Maximum of (2) stains, as selected by Architect from manufacturer's full range.
4. Effect: Open-grain finish.
5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 08 71 00 "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated doors according to NFPA 80.
2. Install smoke- and draft-control doors according to NFPA 105.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

E. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise

indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.

a. Comply with NFPA 80 for fire-rated doors.

2. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
3. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 14 16

SECTION 08 14 33 - STILE AND RAIL WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior stile and rail wood doors.
2. Interior stile and rail wood doors.
3. Interior fire-rated stile and rail wood doors.
4. Fire-rated wood door frames.

B. Related Requirements:

1. Section 099113 "Exterior Painting", Section 099123 "Interior Painting", Section 099300 "Staining and Transparent Finishing" for field finishing stile and rail doors.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data, including those for stiles, rails, panels, and moldings (sticking); and other pertinent data, including the following:

1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
2. Door elevations, dimensions and location of hardware, lite locations, and glazing thickness.
3. Details of frame for each frame type, including dimensions and profile.
4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
5. Dimensions and locations of mortises and holes for hardware.
6. Clearances and undercuts.
7. Requirements for veneer matching.
8. Doors to be factory primed and finished and application requirements.

C. Samples for Initial Selection: For factory-finished doors and factory-finished door frames.

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.
2. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For door inspector.

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
3. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.

B. Field quality control reports.

C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Special warranties.

B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.7 QUALITY ASSURANCE

A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

B. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies must meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

C. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies must meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in opaque plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.9 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity levels designed for building occupants for the remainder of construction period.
2. Do not deliver or install doors until building is enclosed and weathertight, wet work is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during remainder of construction period.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors and frames that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Delamination of veneer.
b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty must also include installation and finishing that may be required due to repair or replacement of defective doors and frames.
3. Warranty must be in effect during specified period of time from date of Substantial Completion.
4. Warranty Period for Exterior Doors: Five years.
5. Warranty Period for Interior Doors: Five years.
6. Insulating Glass Vision Panels: Five years.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of stile and rail wood door from single manufacturer.

B. Obtain stile and rail wood doors from same fabricator as work in Section 064214 "Stile and Rail Wood Paneling."

C. Provide stile and rail wood doors finished in same shop as work in Section 064214 "Stile and Rail Wood Paneling."

2.2 PERFORMANCE REQUIREMENTS

A. Exterior Door Thermal Transmittance: Maximum whole fenestration product U-factor of 0.40 Btu/sq. ft. x h x deg F, in accordance with AAMA 1503, ASTM E1423, or NFRC 100.

B. Fire-Rated Wood Door and Frame Assemblies: Complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.

C. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

2.3 MATERIALS

A. Use only materials that comply with referenced standards and other requirements specified.

1. Assemble exterior doors, including components, with wet-use adhesives complying with ASTM D5572 for finger joints and with ASTM D5751 for joints other than finger joints.
2. Assemble interior doors, including components, with either dry-use or wet-use adhesives complying with ASTM D5572 for finger joints and with ASTM D5751 for joints other than finger joints.

B. Panel Products: Any of the following unless otherwise indicated:

1. Particleboard: ANSI A208.1, Grade M-2.
2. Medium-density fiberboard (MDF), complying with ANSI A208.2, Grade 130.
3. Hardboard complying with ANSI A135.4.
4. Veneer-core plywood.

C. Safety Glass: Provide products complying with testing requirements in 16 CFR 1201, for Category II materials, unless those of Category I are expressly indicated and permitted.

2.4 EXTERIOR STILE AND RAIL WOOD DOORS

A. Exterior Stile and Rail Wood Doors: Exterior stock doors complying with the AWI, AWMAC, and WI's Architectural Woodwork Standards, or WDMA I.S. 6A, and with other requirements specified.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Marvin, Trustile Reserve Wood Entry Systems, or comparable product by one of the following:

    a. Forte Opening Solutions
    b. VT Industries, Inc.

2. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty.
3. ANSI/WDMA I.S. 1A Quality Grade: Premium.
4. Architectural Woodwork Standards Quality Grade: Premium.
5. Panel Designs: As indicated on Drawings.

    a. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval.
    b. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

6. Finish: Transparent.
7. Wood Species and Cut for Transparent Finish: Species to match existing or As Selected by Architect from manufacturer’s full range
8. Door Construction for Transparent Finish:

    a. Stile and Rail Construction:

        1) Clear lumber; may be edge glued for width. Select lumber for similarity of grain and color, and arrange for optimum match between adjacent pieces.
        2) Veneered, structural composite lumber. Select veneers for similarity of grain and color, and arrange for optimum match between adjacent pieces.

    b. Raised-Panel Construction:

        1) Clear lumber; edge glued for width. Select lumber for similarity of grain and color, and arrange for optimum match between adjacent pieces.
        2) Edge-glued, clear lumber; glued to both sides of a wood-based panel product. Select lumber for similarity of grain and color, and arrange for optimum match between adjacent pieces.
        3) Veneered, wood-based panel product with mitered, raised rims made from matching clear lumber.
        4) Veneered, shaped, wood-based panel product with veneer conforming to raised-panel shape.

9. Door Construction for Opaque Finish:

    a. Stile and Rail Construction:

        1) Clear softwood; may be edge glued for width and finger jointed.
        2) Veneered, structural composite lumber [or veneered edge- and end-glued lumber] .

    b. Raised-Panel Construction: Clear softwood lumber; edge glued for width.

10. Stile and Rail Widths: As indicated on Drawings.
11. Raised-Panel Thickness: As indicated on Drawings.
12. Molding Profile (Sticking): As selected by Architect from manufacturer's full range.
13. Glass: complying with Section 088000 "Glazing."
14. Mark, label, or otherwise identify stile and rail wood doors as complying with WDMA I.S. 6A and grade specified.

2.5 INTERIOR STILE AND RAIL WOOD DOORS

A. Interior Stile and Rail Wood Doors: Interior stock doors complying with AWI, AWMAC, and WI's Architectural Woodwork Standards and with other requirements specified.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Marvin
    b. ETO Doors Corp.
    c. Forte Opening Solutions
    d. Karona by JELD-WEN
    e. VT Industries, Inc.

2. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty
3. ANSI/WDMA I.S. 1A Quality Grade: Custom.
4. Architectural Woodwork Standards Quality Grade: Custom.
5. Panel Designs: Indicated on Drawings. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
6. Finish: Transparent unless otherwise indicated.
7. Wood Species and Cut for Transparent Finish: Species to match existing or as Selected by Architect from Manufacturer’s full range.
8. Door Construction for Transparent Finish:

    a. Stile and Rail Construction:

        1) Clear lumber; may be edge glued for width. Select lumber for similarity of grain and color, and arrange for optimum match between adjacent pieces.
        2) Veneered, structural composite lumber. Select veneers for similarity of grain and color, and arrange for optimum match between adjacent pieces.

    b. Raised-Panel Construction:

        1) Clear lumber; edge glued for width. Select lumber for similarity of grain and color, and arrange for optimum match between adjacent pieces.
        2) Edge-glued, clear lumber; glued to both sides of a wood-based panel product. Select lumber for similarity of grain and color, and arrange for optimum match between adjacent pieces.
        3) Veneered, wood-based panel product with mitered, raised rims made from matching clear lumber.
        4) Veneered, shaped, wood-based panel product with veneer conforming to raised-panel shape.

    c. Flat-Panel Construction: Veneered, wood-based panel product.

9. Door Construction for Opaque Finish:

    a. Stile and Rail Construction:

        1) Clear softwood; may be edge glued for width and finger jointed.
        2) Veneered, structural composite lumber

    b. Raised-Panel Construction: Clear softwood lumber; edge glued for width
    c. Flat-Panel Construction: Veneered, wood-based panel product

10. Stile and Rail Widths: As indicated.
11. Raised-Panel Thickness: As indicated
12. Flat-Panel Thickness: As indicated
13. Molding Profile (Sticking): As selected by Architect from manufacturer's full range.
14. Glass: complying with Section 088000 "Glazing."

15. Mark, label, or otherwise identify stile and rail wood doors as complying with WDMA I.S. 6A and grade specified.

2.6 INTERIOR FIRE-RATED STILE AND RAIL WOOD DOORS

A. Rated, Interior Fire-Rated Stile and Rail Wood Doors: Fire-rated as indicated on drawings, doors complying with AWI, AWMAC, and WI's Architectural Woodwork Standards and with other requirements specified.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Marvin
    b. ETO Doors Corp.
    c. Forte Opening Solutions
    d. Karona by JELD-WEN
    e. VT Industries, Inc.

2. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty.
3. ANSI/WDMA I.S. 1A Quality Grade: Custom.
4. Architectural Woodwork Standards Quality Grade: Custom.
5. Panel Designs: Indicated on Drawings. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
6. Finish: Transparent unless otherwise noted.
7. Wood Species and Cut for Transparent Finish: Species to match existing or as Selected by Architect from Manufacturer’s full range.

8. Door Construction for Transparent Finish: 1-3/4-inch- thick stiles and rails and veneered panels to match existing. Flat panels not less than 5/8 inch thick, raised panels not less than 1-1/8 inches thick.

    a. Stile and Rail Construction: Veneered, structural composite lumber. Select veneers for similarity of grain and color, and arrange for optimum match between adjacent pieces.
    b. Raised-Panel Construction: Veneered, shaped, wood-based panel product with veneer conforming to raised-panel shape.
    c. Flat-Panel Construction: Veneered, wood-based panel product.
    d. Edge Construction for Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
    e. Edge Construction for Fire-Rated Pairs of Doors:

        1) Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
        2) Provide formed-steel edges and astragals with intumescent seals.

            a) Finish steel edges and astragals with baked enamel same color as doors.
            b) Finish steel edges and astragals to match door hardware (locksets or exit devices).

9. Door Construction for Opaque Finish: 1-3/4-inch- thick stiles and rails and veneered panels to match existing. Flat panels not less than 5/8 inch thick, raised panels not less than 1-1/8 inches thick.

    a. Stile and Rail Construction: Veneered, structural composite lumber.
    b. Raised-Panel Construction: Shaped medium-density fiberboard (MDF.)
    c. Flat-Panel Construction: Veneered, wood-based panel product
    d. Edge Construction for Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
    e. Edge Construction for Fire-Rated Pairs of Doors:

1) Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
2) Provide formed-steel edges and astragals with intumescent seals.

a) Finish steel edges and astragals with baked enamel same color as doors.
b) Finish steel edges and astragals to match door hardware (locksets or exit devices).

10. Stile and Rail Widths: As indicated on Drawings
11. Molding Profile (Sticking): As selected by Architect from manufacturer's full range.
12. Mark, label, or otherwise identify stile and rail wood doors as complying with WDMA I.S. 6A and grade specified.

2.7 FIRE-RATED WOOD DOOR FRAMES

A. Interior Frames:

1. Architectural Woodwork Standards Quality Grade: Premium.
2. WDMA I.S. 6A Quality Grade: Premium.
3. Wood Species and Cut: Match species and cut indicated for wood doors unless otherwise indicated.
4. Species: Species to match existing or as Selected by Architect from Manufacturer’s full range.
5. Cut: To match existing .
6. Wood Moisture Content: 5 to 10 percent.
7. Profile: To match existing or As indicated on Drawings .
8. Construction: Solid lumber, fire-retardant particleboard, or fire-retardant medium density fiberboard (MDF) with veneered exposed surfaces and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated on Drawings.

2.8 STILE AND RAIL WOOD DOOR FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels unless otherwise indicated:

1. Clearances:

a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
b. Provide 1/2 inch from bottom of door to top of decorative floor finish or covering.
c. Where threshold is shown on Drawings or scheduled, provide not more than 3/8 inch from bottom of door to top of threshold.
d. Comply with NFPA 80 requirements for fire-rated doors.

2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
3. Bevel fire-rated doors 1/8 inch in 2 inches on lock edge; trim stiles and rails only to extent permitted by labeling agency.

B. Fabricate stile and rail wood doors in sizes indicated for field fitting.

C. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.
2. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
3. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
4. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.

D. Glazed Openings:

1. Trim openings indicated for glazing with solid-wood moldings, with one side removable. Miter wood moldings at corner joints.
2. Factory install glazing in doors, complying with Section 088000 "Glazing." Install glass using manufacturer's standard elastomeric glazing sealant complying with ASTM C920. Secure glass in place with removable wood moldings. Miter wood moldings at corner joints.

E. Transom and Side Panels:

1. Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors.
2. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
3. Fabricate door and transom panels with full-width, solid-lumber [, rabbeted,] meeting rails.
4. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.

F. Exterior Doors: Factory treat exterior doors with water-repellent preservative after fabrication has been completed but before shop priming.

1. Comply with WDMA I.S. 4.
2. Flash top of outswinging doors with manufacturer's standard metal flashing.

2.9 FACTORY PRIMING

A. Doors for Opaque Finish: Shop prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in Section 099113 "Exterior Painting." And Section 099123 "Interior Painting."

2.10 FACTORY FINISHING

A. Comply with referenced quality standard for factory finishing.

1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
2. Finish faces, all four edges, edges of cutouts, and mortises.
3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Factory finish doors that are indicated to receive transparent finish.

D. Factory finish doors where indicated in schedules or on Drawings.

E. Transparent Finish:

1. Architectural Woodwork Standards Grade: Premium.

   a. System 5, varnish, conversion.
   b. System 9, UV Curable, Acrylated Epoxy, Polyester, or Urethane.
   c. System 10, UV Curable, Water Based.
   d. System 11, Polyurethane, Catalyzed.

2. WDMA I.S. 6A Grade: Premium.

   a. TR-4 Conversion Varnish.
   b. TR-6 Catalyzed Polyurethane.
   c. TR-8 UV Cured Acrylated Polyester/Urethane.

3. Staining: As selected by Architect from manufacturer's full range.
4. Effect: To match existing.
5. Sheen: To match existing.

F. Opaque Finish:

1. Architectural Woodwork Standards Grade: Premium.

   a. System 5, Varnish, Conversion.
   b. System 9, UV Curable, Acrylated Epoxy, Polyester, or Urethane.
   c. System 10, UV Curable, Water Based.
   d. System 11, Polyurethane, Catalyzed.

2. WDMA I.S. 6A Grade: Premium.

   a. OP-4 Conversion Varnish.
   b. OP-6 Catalyzed Polyurethane.

3. Color: As selected by Architect from manufacturer's full range.
4. Sheen: Match Existing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated door frames in accordance with NFPA 80.

   a. Install frames level, plumb, true, and straight.

      1) Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

   b. Anchor frames to anchors or blocking built in or directly attached to substrates.

      1) Secure with countersunk, concealed fasteners and blind nailing.
      2) Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.

   c. For shop-finished items, use filler matching finish of items being installed.

2. Install fire-rated doors in accordance with NFPA 80.
3. Install smoke- and draft-control doors in accordance with NFPA 105.

C. Job-Fitted Doors:

1. Align and fit doors in frames with uniform clearances and bevels as indicated below.

a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.

2. Machine doors for hardware.
3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
4. Clearances:

   a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
   b. Provide 1/4 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
   c. Where threshold is shown on Drawings or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
   d. Comply with NFPA 80 for fire-rated doors.

5. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
6. Bevel fire-rated doors 1/8 inch in 2 inches on lock edge; trim stiles and rails only to extent permitted by labeling agency.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory- Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 14 33

SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Access doors and frames.
2. Fire-rated access doors and frames.

B. Related Requirements:

1. Section 07 72 00 "Roof Accessories" for roof hatches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.

B. Product Schedule: For access doors and frames.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing and inspecting agency.

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.

1.5 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

1.6 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies meets the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flanges

1. Products: Subject to compliance with requirements, provide the following or equal:

    a. Best Access Doors BA-UF-5000-PC-32-32

2. Description: Face of door flush with frame, with exposed flange and concealed hinge.
3. Locations: Wall
4. Door Size: 32”x32”
5. Steel Sheet for Door: Nominal 0.060 inch (1.52 mm) , 16 gage, factory primed.
6. Frame Material: Same material, thickness, and finish as door
7. Latch and Lock: Cam latch, screwdriver operated

2.3 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush Access Doors with Exposed Flanges

1. Products: Subject to compliance with requirements, provide the following or equal:

    a. Best Access Doors BA-PFN-32-32

2. Description: Door face flush with frame, with exposed flange, self-closing door, and concealed hinge.
3. Locations: Wall
4. Door Size: 32”x32”
5. Fire-Resistance Rating: Not less than that of adjacent construction
6. Steel Sheet for Door: Nominal 0.060 inch (1.52 mm) , 16 gage, factory primed.
7. Frame Material: Same material, thickness, and finish as door
8. Latch and Lock: Cam latch, screwdriver operated

2.4 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

D. Frame Anchors: Same material as door face.

E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.5 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.

2.6 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
2. Factory Finished: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning and pretreating, with minimum dry-film thickness of 1 mil (0.025 mm) for topcoat.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 FIELD QUALITY CONTROL

A. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated access door in accordance with NFPA 80, Section 5.2.

B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

D. Prepare and submit separate inspection report for each fire-rated access door indicating compliance with each item listed in NFPA 80.

3.4 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 08 31 13

SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Aluminum-framed storefront systems.
2. Aluminum-framed entrance door systems.

B. Related Requirements:

1. Section 07 92 00 "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain walls and for sealants to the extent not specified in this Section.
2. Section 08 44 13 "Glazed Aluminum Curtainwalls" for other aluminum framing systems.
3. Section 08 80 00 "Glazing" for storefront glazing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:

a. Joinery, including concealed welds.
b. Anchorage.
c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
4. Include point-to-point wiring diagrams showing the following:

a. Power requirements for each electrically operated door hardware.
b. Location and types of switches, signal device, conduit sizes, and number and size of wires.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

F. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Installer.
2. For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.

B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.

C. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by a qualified testing agency.

D. Source quality-control reports.

E. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Laboratory Mockup Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

C. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated and acceptable to Owner and Architect.

D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

E. Structural-Sealant Glazing: Comply with ASTM C1401 for design and installation of storefront systems that include structural glazing.

1.8 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 WARRANTY

A. Special Warranty: Manufacturer and Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including, but not limited to, excessive deflection.
b. Noise or vibration created by wind and thermal and structural movements.
c. Water penetration through fixed glazing and framing areas.
d. Failure of operating components.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 10 years from date of Substantial Completion.

C. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, peeling, or chipping.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing spandrel panels venting windows and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

B. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings .

C. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm) , whichever is smaller .

a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.

3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:

a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans of less than 11 feet 8-1/4 inches (3.6 m).

D. Structural: Test according to ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:

1. Fixed Framing and Glass Area:

a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).

2. Entrance Doors:

a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static-air-pressuredifferential of 1.57 lbf/sq. ft. (75 Pa).
b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. (2.54 L/s per sq. m) at a static-air-pressuredifferential of 1.57 lbf/sq. ft. (75 Pa).

F. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa) .

G. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation

H. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):

a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K) as determined according to NFRC 100.
b. Entrance Doors: U-factor of not more than 0.77 Btu/sq. ft. x h x deg F (4.37 W/sq. m x K) as determined according to NFRC 100.
c. Venting Windows: Whole window U-factor of not more than 0.37 Btu/sq. ft. x h x deg F (2.10 W/sq. m x K) as determined according to NFRC 100.

2. Air Leakage:

a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa) when tested according to ASTM E283.
b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
c. Venting Windows: Whole window air leakage of not more than 0.3 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa) when tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.

3. Condensation Resistance Factor (CRF):

a. Fixed Glazing and Framing Areas: CRF for the system of not less than 35 as determined according to AAMA 1503.
b. Entrance Doors: CRF of not less than 57 as determined according to AAMA 1503.
c. Venting Windows: Whole window CRF of not less than 45 as determined according to AAMA 1503.

I. Noise Reduction: Test according to ASTM E90, with ratings determined by ASTM E1332, as follows.

1. Outdoor-Indoor Transmission Class: Minimum 26 .

J. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C) .
b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C) .
c. Interior Ambient-Air Temperature: 75 deg F (24 deg C) .

K. Structural-Sealant Joints:

1. Designed to carry gravity loads of glazing.

L. Structural Sealant: ASTM C1184. Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed, aluminum-framed entrances and storefronts without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.

1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate, because sealant-to-substrate bond strength exceeds sealant's internal strength.

2.3 STOREFRONT SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide YKK YES 45TU system or equal by one of the following:

1. EFCO Corporation
2. Kawneer N.A.

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: Thermally broken .
2. Interior Vestibule Framing Construction: Nonthermal .
3. Glazing System: Retained mechanically with gaskets on four sides .
4. Glazing Plane: Refer to drawings.
5. Finish: Clear anodic finish.
6. Fabrication Method: Field-fabricated stick system.
7. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
8. Steel Reinforcement: As required by manufacturer.

C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

E. Insulated Spandrel Panels:

1. Laminated, metal-faced flat panels with no deviations in plane exceeding 0.8 percent of panel dimension in width or length.

a. Overall Panel Thickness: 1 inch (25.4 mm) .
b. Exterior Skin: Aluminum.

1) Thickness: Manufacturer's standard for finish and texture indicated .
2) Finish: Match framing system .
3) Texture: Smooth .
4) Backing Sheet: 1/8-inch- (3.2-mm-) thick tempered hardboard .

c. Interior Skin: Aluminum.

1) Thickness: Manufacturer's standard for finish and texture indicated .
2) Finish: Matching storefront framing .
3) Texture: Smooth .
4) Backing Sheet: 1/8-inch-(3.2-mm-) thick tempered hardboard .

d. Thermal Insulation Core: Manufacturer's standard rigid, closed-cell, polyisocyanurate board extruded-polystyrene board .

e. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1) Flame-Spread Index: 25 or less.
2) Smoke-Developed Index: 50 or less.

F. Venting Windows:

1. Manufacturer's standard units, complying with AAMA/WDMA/CSA 101/I.S.2/A440, with self-flashing mounting fins, and as follows:

a. Window Type: Awning .
b. Minimum Performance Class: AW .
c. Minimum Performance Grade: 40 .
d. Hardware: Manufacturer's standard; of aluminum, stainless steel, die-cast steel, malleable iron, or bronze; including the following:

1) Cam handle locking system.
2) Multi-point locking system.
3) Pole-operated, cam handle locking system, where rail is more than 72 inches (1830 mm) above floor.
4) Rotary operator.
5) Steel or bronze operating arms.
6) Limit Devices: Concealed friction adjustor and adjustable stay bar limit devices designed to restrict sash opening.

a) Limit clear opening to 4 inches (100 mm) for ventilation; with custodial key release.

e. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

f. Insect Screens: Provide removable insect screen on each operable exterior sash, with screen frame finished to match window unit, complying with SMA 1004 or SMA 1201, and as follows:

1) Aluminum Wire Fabric: 18-by-18, 0.0445-inch-by-0.0445-inch (1.1-by-1.1-mm); 18-by-16, 0.0445-inch-by-0.0515-inch (1.1-by-1.3-mm); or 18-by-14, 0.0445-inch-by-0.0624-inch (1.1-by-1.5-mm) mesh of 0.013-inch- (0.3-mm-) diameter, coated aluminum wire.
2) Glass-Fiber Mesh Fabric: 18-by-16 0.0445-inch-by-0.0515-inch (1.1-by-1.3-mm) or 18-by-14 0.0445-inch-by-0.0624-inch (1.1-by-1.5-mm) mesh of PVC-coated, glass-fiber threads, woven and fused to form a fabric mesh; complying with ASTM D3656/D3656M.
3) Fabric: Manufacturer's standard aluminum wire fabric or glass-fiber mesh fabric.

g. Glazing: Same as adjacent aluminum-framed entrances and storefront glazing .

h. Finish: Match adjacent aluminum-framed entrances and storefront finish .

2.4 ENTRANCE DOOR SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide YKK 50D Monumental Commercial Entrance or equal by one of the following:

1. EFCO Corporation
2. Kawneer N.A.

B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 2-inch (50.8-mm) overall thickness, with minimum 0.188-inch- (4.8-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior .

2. Door Design: As indicated on drawings. Otherwise Wide stile; 5-inch (127-mm) nominal width.
3. Glazing Stops and Gaskets: Square , snap-on, extruded-aluminum stops and preformed gaskets.

a. Provide nonremovable glazing stops on outside of door.

4. Finish: Match adjacent storefront framing finish.

2.5 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 08 71 00 "Door Hardware."

B. Designations: Requirements for design, grade, function, finish, quantity, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

2.6 ALUMINUM VENTILATION GRILLE PANELS

A. Aluminum tube frame: 4 ½ inch deep tube frame by dimensions indicated on drawings.

B. Panels: Panels comprised of horizontal and vertical 3 inch by 1/8 inch flat aluminum bars per drawings.

2.7 GLAZING

A. Glazing: Comply with Section 08 80 00 "Glazing."

B. Glazing Gaskets: Comply with Section 08 80 00 "Glazing."

C. Weatherseal Sealants: ASTM C920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed storefront manufacturers for this use.

1. Color: Match structural sealant.

2.8 MATERIALS

A. Sheet and Plate: ASTM B209 (ASTM B209M).

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).

C. Extruded Structural Pipe and Tubes: ASTM B429/B429M.

D. Structural Profiles: ASTM B308/B308M.

E. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

F. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

2.9 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads , finished to match framing system .

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials .

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.10 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

D. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.

E. Storefront Framing: Fabricate components for assembly using screw-spline system .

F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At interior and exterior doors, provide compression weather stripping at fixed stops.

G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.11 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, or thicker.

2.12 SOURCE QUALITY CONTROL

A. Structural Sealant: Perform quality-control procedures complying with ASTM C1401 recommendations, including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Seal perimeter and other joints watertight unless otherwise indicated.

G. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

H. Set continuous sill members and flashing in full sealant bed, as specified in Section 07 92 00 "Joint Sealants," to produce weathertight installation.

I. Install joint filler behind sealant as recommended by sealant manufacturer.

J. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF OPERABLE UNITS

A. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

3.4 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 08 80 00 "Glazing."

3.5 INSTALLATION OF STRUCTURAL GLAZING

A. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

B. Set glazing into framing according to sealant manufacturer and framing manufacturer's written instructions and standard practice. Use a spacer or backer as recommended by manufacturer.

C. Set glazing with proper orientation so that coatings face exterior or interior as specified.

D. Hold glazing in place using temporary retainers of type and spacing recommended by manufacturer, until structural sealant joint has cured.

E. Apply structural sealant to completely fill cavity, according to sealant manufacturer and framing manufacturer's written instructions and in compliance with local codes.

F. Apply structural sealant at temperatures indicated by sealant manufacturer for type of sealant.

G. Allow structural sealant to cure according to manufacturer's written instructions.

H. Clean and protect glass as indicated in Section 08 80 00 "Glazing."

3.6 INSTALLATION OF WEATHERSEAL SEALANT

A. After structural sealant has completely cured, remove temporary retainers and insert backer rod between lites of glass as recommended by sealant manufacturer.

B. Install weatherseal sealant to completely fill cavity, according to sealant manufacturer's written instructions, to produce weatherproof joints.

3.7 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS

A. Install entrance doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.

2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.8 ERECTION TOLERANCES

A. Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
3. Alignment:

   a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
   b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
   c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).

4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

END OF SECTION 08 41 13

SECTION 08 44 13 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Glazed aluminum curtain wall systems.

a. Conventionally glazed.

B. Related Requirements:

1. Section 07 92 00 "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain walls and for sealants to the extent not specified in this Section.
2. Section 08 41 13 "Aluminum-Framed Entrances and Storefronts" for other aluminum framing systems.
3. Section 08 80 00 "Glazing" for curtain wall glazing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each type of vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:

a. Joinery, including concealed welds.
b. Anchorage.
c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

D. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.

3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Installer and laboratory mockup testing agency .
2. For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.

B. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.

C. Product Test Reports: For glazed aluminum curtain walls, for tests performed by a qualified testing agency.

D. Quality-Control Program: Developed specifically for Project, including fabrication and installation, in accordance with recommendations in ASTM C1401. Include periodic quality-control reports.

E. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Laboratory Mockup Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated .

C. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and acceptable to Owner and Architect.

D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.8 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Testing shall be performed on mockups in accordance with requirements in "Field Quality Control" Article.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PRECONSTRUCTION LABORATORY MOCKUPS

A. Build preconstruction laboratory mockups at testing agency facility; use personnel, products, and methods of construction that will be used at Project site.

B. Preconstruction Laboratory Mockup Testing Program: Test preconstruction laboratory mockups according to requirements in "Performance Requirements" Article. Perform the following tests in the following order:

1. Structural: ASTM E 330 at 50 percent of positive test load.
2. Air Infiltration: ASTM E 283.
3. Water Penetration under Static Pressure: ASTM E 331.
4. Water Penetration under Dynamic Pressure: AAMA 501.1.
5. Structural: ASTM E 330 at 100 percent of positive and negative test loads. Repeat the following:

   a. Air Infiltration: ASTM E 283.
   b. Water Penetration under Static Pressure: ASTM E 331.

6. Interstory Drift: AAMA 501.4 at 100 percent of design displacement. Repeat the following:

   a. Air Infiltration: ASTM E 283.
   b. Water Penetration under Static Pressure: ASTM E 331.

7. Vertical Interstory Movement: AAMA 501.7. Repeat the following:

   a. Air Infiltration: ASTM E 283.
   b. Water Penetration under Static Pressure: ASTM E 331.

8. Thermal Cycling: According to AAMA 501.5. Repeat the following:

   a. Air Infiltration: ASTM E 283.
   b. Water Penetration under Static Pressure: ASTM E 331.

9. Structural: ASTM E 330 at 100 and 150 percent of positive and negative test loads. Repeat the following:

   a. Air Infiltration: ASTM E 283.
   b. Water Penetration under Static Pressure: ASTM E 331.

1.10 WARRANTY

A. Special Assembly Warranty: Manufacturer and Installer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures including, but not limited to, excessive deflection.
   b. Noise or vibration created by wind and thermal and structural movements.
   c. Deterioration of metals , metal finishes, and other materials beyond normal weathering.
   d. Water penetration through fixed glazing and framing areas.
   e. Failure of operating components.

2. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

C. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, peeling, or chipping.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls shall withstand movements of supporting structure, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

B. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings .

C. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans of greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm) , whichever is smaller .

a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.

3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:

    a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4-inch (6.35-mm) for spans of greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans of less than 11 feet 8-1/4 inches (3.6 m).

D. Structural: Test in accordance with ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa) .

F. Energy Performance: Certified and labelled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):

    a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.38 Btu/sq. ft. x h x deg F (2.16 W/sq. m x K) as determined in accordance with NFRC 100.
    b. Venting Windows: Whole window U-factor of not more than 0.37 Btu/sq. ft. x h x deg F (2.10 W/sq. m x K) as determined in accordance with NFRC 100.

2. Air Leakage:

    a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa) when tested in accordance with ASTM E283.
    b. Venting Windows: Whole-window air leakage of not more than 0.3 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa) when tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.

3. Condensation Resistance Factor (CRF):

    a. Fixed Glazing and Framing Areas: CRF for the system of not less than 29 as determined in accordance with AAMA 1503.
    b. Venting Windows: Whole-window CRF of not less than 45 as determined in accordance with AAMA 1503.

G. Noise Reduction: Test in accordance with ASTM E90, with ratings determined by ASTM E1332, as follows:

1. Outdoor-Indoor Transmission Class: Minimum 26 .
2. Sound Transmission Class: Minimum 31 .

H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested in accordance with AAMA 501.5.

a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C) .
b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C) .

2.2 SOURCE LIMITATIONS

A. Obtain all components of curtain-wall system and storefront system, including framing spandrel panels entrances and accessories, from single manufacturer.

2.3 GLAZED ALUMINUM CURTAIN WALL SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide YKK AP America Inc.; YCW750OG or comparable product by one of the following:

1. EFCO Corporation.
2. Kawneer Company, Inc.; Arconic Corporation.

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken .
2. Glazing System: Retained mechanically with gaskets on four sides .
3. Glazing Plane: Front .
4. Finish: Clear anodic finish .
5. Fabrication Method: Either factory- or field-fabricated system .
6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
7. Steel Reinforcement: As required by manufacturer.

C. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

E. Insulated Spandrel Panels:

1. Laminated, metal-faced flat panels with no deviations in plane exceeding 0.8 percent of panel dimension in width or length.

a. Overall Panel Thickness: As indicated 1 inch (25.4 mm) .
b. Exterior Skin: Aluminum.

1) Thickness: Manufacturer's standard for finish and texture indicated .
2) Finish: Match framing system .
3) Texture: Smooth .
4) Backing Sheet: 1/8-inch- (3.2-mm-) thick, tempered hardboard .

c. Interior Skin: Aluminum .

1) Thickness: Manufacturer's standard for finish and texture indicated .
2) Finish: Matching curtain-wall framing .
3) Texture: Smooth .
4) Backing Sheet: 1/8-inch- (3.2-mm-) thick, tempered hardboard .

d. Thermal Insulation Core: Manufacturer's standard rigid, closed-cell, polyisocyanurate board.
e. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1) Flame-Spread Index: 25 or less.
2) Smoke-Developed Index: 50 or less.

F. Entrance Door Systems: Comply with Section 08 41 13 "Aluminum-Framed Entrances and Storefronts" .

2.4 GLAZING

A. Glazing: Comply with Section 08 80 00 "Glazing."

B. Glazing Gaskets: ASTM C509 or ASTM C864. Comply with Section 08 80 00 "Glazing." .

1. Color: Black .

C. Glazing Sealants: Comply with Section 08 80 00 "Glazing."

D. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less.

E. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

F. Weatherseal Sealants: ASTM C920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes into contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed curtain-wall manufacturers for this use.

1. Color: Match structural sealant.

2.5 MATERIALS

A. Sheet and Plate: ASTM B209 (ASTM B209M).

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).

C. Extruded Structural Pipe and Tubes: ASTM B429/B429M.

D. Structural Profiles: ASTM B308/B308M.

E. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

F. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.6 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads , finished to match framing system .

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials .

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
6. Provisions for safety railings mounted on interior face of mullions .
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
8. Components curved to indicated radii.

D. Fabricate components to resist water penetration as follows:

1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

E. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method .

F. Factory-Assembled Frame Units:

1. Rigidly secure nonmovement joints.
2. Prepare surfaces that are in contact with structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
3. Seal joints watertight unless otherwise indicated.
4. Install glazing to comply with requirements in Section 08 80 00 "Glazing."

G. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.8 ALUMINUM FINISHES

A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.

G. Seal joints watertight unless otherwise indicated.

H. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

I. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

J. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF OPERABLE UNITS

A. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

3.4 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 08 80 00 "Glazing."

3.5 ERECTION TOLERANCES

A. Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
3. Alignment:

    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
    c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).

4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

END OF SECTION 08 44 13

SECTION 08 52 00 - WOOD WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes wood window complete with glazing, simulated divided lite, jamb extension, and standard or specified anchors, trim, attachments, and accessories.

B. Related Requirements:

1. Section 07 92 00 "Joint Sealants" for installation of joint sealants installed with wood windows.
2. Section 08 80 00 "Glazing" for additional glazing information.

C. References

1. American Society for Testing Materials (ASTM):

   a. E283: Standard Test Method for Rate of Air Leakage through Exterior Windows, Curtain Walls and Doors
   b. E330: Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls and Door by Uniform Static Air Pressure Difference
   c. E547: Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Cyclic Static Air Pressure Differential
   d. E2112: Standard Practice for Installation of Exterior Windows, Doors, and Skylights
   e. E2190: Specification for Sealed Insulated Glass Units
   f. C1036: Standard Specification for Flat Glass
   g. E1996: Standard Specification for Performance of Exterior Windows, Curtain Walls and Doors and Storm Shutters Impacted by Windborne Debris in Hurricanes
   h. E1886: Standard Test Method for Performance of Exterior Windows, Curtain walls, Doors, and Storm Shutters Impacted by Missile (s) and Exposed to Cyclic Pressure Differentials

2. American Architectural Manufacturer's Association/Window and Door Manufacturer's Association (AAMA/WDMA/CSA):

   a. AAMA/WDMA/CSA 101/I.S.2/A440-08, North American Fenestration, Standard/Specification for Window, Doors and Skylights
   b. AAMA/WDMA/CSA 101/I.S.2/A440-11, NAFS 2011 – North American Fenestration, Standard/Specification for Windows, Doors and Skylights

3. WDMA I.S.4: Industry Standard for Water Repellant Preservative Treatment for Millwork
4. Window and Door Manufacturer's Association (WDMA): 101/I.S.2 WDMA Hallmark Certification Program
5. Sealed Insulating Glass Manufacturer's Association/Insulating Glass Certification Council (SIGMA/IGCC)
6. American Architectural Manufacturer's Association (AAMA): 2605: Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels
7. National Fenestration Rating Council (NFRC):

   a. 101: Procedure for Determining Fenestration Product Thermal Properties
   b. 200: Procedure for Determining Solar Heat Gain Coefficients at Normal Incidence

8. Window Covering Manufacturer's Association

   a. A100.1: Standard for safety of corded window covering products

1.3 SYSTEM DESCRIPTION

A. Design and Performance Requirements:

1. Window units shall be designed to comply with ASTM E1996 Wind Zone 3 Missile Level D Rating +55/-65 psf
2. Air leakage shall not exceed the following when tested at 1.57 psf according to ASTM E283: 0.30 cfm per square foot of frame
3. No water penetration when tested at the following pressure according to ASTM E547: 8.25psf
4. Assembly shall withstand a positive or negative uniform static air pressure difference psf +82.5/-97.5 psf without damage
5. Impact and cycling per ASTM E1996 and E1886 with passing results for Missile Level D and Pressure Cycling of +55/-65 psf

1.4 SUBMITTALS

A. Shop Drawings: Submit shop drawings under provision of Section 01 33 00.

1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

B. Product Data: Submit product data for certified options under provision of Section 01 33 00. Product performance rating information may be provided via quote, performance rating summary (NFRC Data), or certified performance grade summary (WDMA Hallmark data).

C. Samples for Verification: For wood windows and components required, prepared on Samples of size indicated below:

1. Exposed Finishes: 2 by 4 inches(50 by 100 mm).
2. Exposed Hardware: Full-size units.

1.5 QUALITY ASSURANCE

A. Requirements: consult local code for IBC [International Building Code] adoption year and pertinent revisions.

B. Installer Qualifications: An installer acceptable to wood window manufacturer for installation of units required for this Project.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical wall area as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY

A. Deliver in original packaging and protect from weather.

1.7 STORAGE AND HANDLING

A. Prime and seal wood surfaces, including to be concealed by wall construction, if more than thirty (30) days will expire between delivery and installation.

B. Store window units in an upright position in a clean and dry storage area above ground to protect from weather under provision of Section 01 66 00.

1.8 WARRANTY

A. Complete and current warranty information is available at marvin.com/warranty. The following summary is subject to the terms, conditions, limitations and exclusions set forth in the Marvin Windows and Door Limited Warranty and Products in Coastal Environments Limited Warranty Supplement:

1. Clear insulating glass with stainless steel spacers is warranted against seal failure caused by manufacturing defects and resulting in visible obstruction through the glass for twenty (20) years from the original date of purchase. Glass is warranted against stress cracks caused by manufacturing defects from ten (10) years from the original date of purchase.

2. Factory applied interior finish is warranted to be free from finish defects for a period of five (5) years from the original date of purchase.

3. Hardware and other non-glass components are warranted to be free from manufacturing defects for ten (10) years from the original date of purchase.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain wood windows from single source from single manufacturer.

B. Basis-of-Design: Factory-assembled Ultimate Wood Direct Glaze Polygon window as manufactured by Marvin Windows and Doors, Warroad, Minnesota, or approved equal.

2.2 FRAME DESCRIPTION

A. Non Finger-Jointed Pine or finger-jointed core with non finger-jointed Pine veneer; non finger-jointed Mahogany or finger-jointed core with non finger-jointed Mahogany veneer; non finger-jointed Vertical Grain Douglas Fir or finger-jointed with non finger-jointed Vertical Grain Douglas Fir veneer.

1. Kiln-dried to moisture content no greater than 12 percent at the time of fabrication.
2. Water repellant, preservative treated in accordance with ANSI/WDMA I.S.4.

B. Frame thickness: 1 3/16” ((30mm)

C. Frame depth: 4 9/16” (116mm)

D. Subsill thickness: 15/16” (24mm)

2.3 GLAZING

A. Select quality complying with ASTM C1036. Insulating glass SIGMA/IGCC certified to performance level CBA when tested in accordance with ASTM E2190

B. Glazing method: Insulating glass

C. Glazing seal: Interior: Wood interior glazing stops fastened with 1 3/8” nails, sealed with double sided glazing tape and dual silicone beads at perimeter

D. Glass fill: Air with capillary tubes, Argon

E. Glass Type: E2

2.4 FINISH

A. Interior/Exterior: Treated wood

1. Prime: Factory-applied water-borne acrylic primer. Meets WDMA TM-11 requirements.

B. Interior Finish options:

1. Painted Interior Finish. Factory-applied water-borne acrylic enamel. Available on Pine product only. Available in White or Designer Black. Meets TM-14 requirements.

2. Factory-applied water-borne acrylic enamel clear coat. Applied in two separate coats with light sanding between coats. Available on Pine.

3. Factory-applied water-borne urethane stain. Stain applied over a wood (stain) conditioner. A water-borne acrylic enamel clear coat applied in two separate coats, with light sanding between coats, applied over the stain. Available on Pine.

2.5 JAMB EXTENSION

A. Jamb extensions are available for various wall thickness factory-applied up to a 12” (305mm) wide.

B. Finish: Match interior frame finish.

2.6 SIMULATED DIVIDED LITES (SDL)

A. 5/8” (16mm) wide

1. Standard Sticking: Ogee
2. Optional: Square, Putty (Exterior only)

B. Muntins: Pine

C. Muntins adhere to glass with closed-cell copolymer acrylic foam tape.

D. Pattern: Rectangular

E. Finish: Match panel finish.

2.7 ACCESSORIES AND TRIM

A. Installation Accessories:

1. Factory-installed vinyl nailing/drip cap
2. Installation brackets: 6 3/8” (162mm), 9 3/8” (283mm), 15 3/8” (390mm)
3. Masonry brackets: 6” (152mm), 10” (254mm)

B. Exterior Wood Moulding:

1. Finish: Match exterior frame finish

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Condition: Before installation, verify openings are plumb, square and of proper dimensions as required in Section 01 71 00. Report frame defects or unsuitable conditions to the General contractor before proceeding.

B. Acceptance of Condition: Beginning on installation confirms acceptance of existing conditions.

3.2 INSTALLATION

A. Comply with Section 01 73 00.

B. Assemble and install window/door unit(s) according to manufacturer's instruction and review shop drawing.

C. Install sealant and related backing materials at perimeter of unit or assembly in accordance with Section 07 92 00 Joint Sealants. Do not use expansive foam sealant.

D. Install accessory items as required.

E. Use finish nails to apply wood trim and mouldings.

3.3 FIELD QUALITY CONTROL

A. Remove visible labels and adhesive residue according to the manufacturer's instructions.

B. Unless otherwise specified, air leakage resistance tests shall be conducted at a uniform static pressure of 75 Pa (~1.57 psf). The maximum allowable rate of air leakage shall not exceed 2.3 L/sm2 (~0.45 cfm/ft2).

C. Unless otherwise specified, water penetration resistance testing shall be conducted per AAMA 502 and ASTM E1105 at 2/3 of the fenestration products design pressure (DP) rating using "Procedure B" – cyclic static air pressure difference. Water penetration shall be defined in accordance with the test method(s) applied.

3.4 CLEANING

A. Remove visible labels and adhesive residue according to manufacturer's instruction.

B. Leave windows and glass in a clean condition. Final cleaning as required in Section 01 74 00.

3.5 PROTECTING INSTALLED CONSTRUCTION

A. Comply with Section 07 76 00.

B. Protecting windows from damage by chemicals, solvents, paint or other construction operations that may cause damage.

END OF SECTION 08 52 00

SECTION 08 56 53 – SECURITY WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fixed, transaction security windows with pass through tray.

B. Related Requirements:

1. Section 08 41 13 “Aluminum-Framed Entrances and Storefronts” for related windows.
2. Section 08 51 13 “Aluminum Windows” for related windows.
3. Section 09 91 23 "Interior Painting" for field painting interior security windows.

1.3 COORDINATION

A. Coordinate installation of anchorages for security windows. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in adjacent construction. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, weights and finishes for window units.

B. Shop Drawings: For security windows.

1. Include plans, elevations, sections, and attachment details.
2. Full-size section details of framing members, including internal armoring, reinforcement, and stiffeners.
3. Glazing details.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data for installer

1.6 QUALITY ASSURANCE

1.7 DELIVERY, STORAGE, AND HANDLING

A. Pack security windows in wood crates for shipment. Crate glazing separate from frames unless factory glazed.

B. Label security window packaging with drawing designation.

C. Store crated security windows on raised blocks to prevent moisture damage.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.9 SEQUENCING

A. Field Painting: Except where security windows have been preglazed before installation, complete field painting of security windows before glazing installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace security windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including deflections exceeding 1/4 inch.
b. Failure of welds.
c. Excessive air leakage.
d. Faulty operation of sliding window hardware.
e. Faulty operation of transaction drawers.
f. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three (3) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Attack Resistance: Provide units identical to those tested for compliance with requirements indicated, and as follows:

1. Ballistics Resistance: As indicated on drawings
~~2. Forced-Entry Resistance: Class 5.0 when tested according to ASTM F 1233.~~

2.2 FIXED, TRANSACTION SECURITY WINDOWS

A. Provide fixed, transaction security windows with operable sash or ventilator capable of allowing transfer of currency and documents.

1. Basis-of Design: Subject to compliance with requirements, provide: Covenant Security Equipment – Quikserv T3 Ticket Teller Windows, Level 3 glass with speak-around frame, integral deal tray and bullet trap flip lid – or approved equal by one of the following manufacturers:

a. Chicago Bullet Proof Systems - exact model must meet all requirements.

B. Configuration: One fixed-glazed panel.

C. Framing: Fabricate perimeter framing, mullions, and glazing stops from aluminum as follows:

1. Profile: Manufacturer's standard with minimum face dimension indicated.

a. Minimum Face Dimension: 2 inches

2. Depth: Manufacturer's standard

D. Head and Jamb Framing: Designed for voice communication by speech at normal volume.

E. Channel-Frame Sill: Formed from stainless steel and designed for sealant glazing.

1. Transaction Counter: Rated plastic laminate or Stainless steel, 12 inches deep by width of security window, with integral deal tray and bullet trap flip lid centered in opening

F. Glazing and Glazing Materials: Comply with requirements in Section 08 80 00 "Security Glazing."

G. Glazing Meeting Edges: Polished glazing.

H. Materials:

1. Mild Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS (Commercial Steel), Type B; suitable for exposed applications.
3. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, CS (Commercial Steel), Type B; with G60 zinc (galvanized) or A60 zinc-iron-alloy (galvannealed) coating designation.
4. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.
5. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666 or ASTM A 240/A 240M, austenitic stainless steel, [Type 304] [Type 316] [Type 304 or 316 as indicated] <Insert type>.
6. Aluminum Extrusions: ASTM B 221. Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength.
7. Aluminum Sheet and Plate: ASTM B 209.

2.3 FABRICATION

A. General: Fabricate security windows to provide a complete system for assembly of components and anchorage of window units.

1. Provide units that are reglazable from the secure side without dismantling the attack side of framing.
2. Prepare security windows for field glazing unless preglazing at the factory is indicated.

B. Framing: Miter or cope corners the full depth of framing; weld and dress smooth.

1. Fabricate framing with manufacturer's standard, internal opaque armoring in thicknesses required for security windows to comply with ballistics-resistance performance indicated.

C. Glazing Stops: Finish glazing stops to match security window framing.

1. Attack-Side (Exterior) Glazing Stops: Welded or integral to framing.
2. Secure-Side (Interior) Glazing Stops: Removable, coordinated with glazing indicated.

D. Welding: Weld components to comply with referenced AWS standard. To greatest extent possible, weld before finishing and in concealed locations to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

E. Metal Protection: Separate dissimilar metals to protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

F. Factory-cut openings in glazing for speaking apertures.

G. Preglazed Fabrication: Preglaze window units at factory, where required for applications indicated. Installation orientation of glazing to meet performance requirements. Comply with requirements in Section 08 80 00 "Glazing."

H. Weather Stripping: Factory applied.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.6 ACCESSORIES

A. Recessed Deal Trays: Formed from stainless steel [with sliding stainless-steel cover]; fabricated in curved shape with exposed flanges for recessed installation into horizontal surface.

1. Clear Opening Size: 12 inches wide by 8 inches deep by 1-1/2 inches high.

B. Concealed Bolts: ASTM A 307, Grade A unless otherwise indicated.

C. Embedded Plate Anchors: Fabricated from mild steel shapes and plates, minimum 3/16 inch thick; with minimum 1/2-inch- diameter, headed studs welded to back of plate.

D. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

E. Glazing Strips and Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Molded EPDM or neoprene gaskets complying with ASTM D 2000, Designations 2BC415 to 3BC620; molded PVC gaskets complying with ASTM D 2287; or molded, expanded EPDM or neoprene gaskets complying with ASTM C 509, Grade 4.
2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric backing.

F. Miscellaneous Glazing Materials: Provide material, size, and shape complying with requirements of glass manufacturers and with a proven record of compatibility with surfaces contacted in installation.

1. Cleaners, Primers, and Sealers: Type recommended by sealant or gasket manufacturer.
2. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85, plus or minus 5.
3. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
4. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

G. Anchors, Clips, and Window Accessories: Stainless steel; hot-dip, zinc-coated steel or iron, complying with ASTM B 633; provide sufficient strength to withstand design pressures indicated.

H. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

I. Sealants: For sealants required within fabricated security windows, provide type recommended by manufacturer for joint size and movement. Sealant shall remain permanently elastic, nonshrinking, and nonmigrating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of security windows.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of security window connections before security window installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of security windows.

D. Inspect built-in and cast-in anchor installations, before installing security windows, to verify that anchor installations comply with requirements. Prepare inspection reports.

1. Remove and replace anchors where inspections indicate that they do not comply with specified requirements. Reinspect after repairs or replacements are made.
2. Perform additional inspections to determine compliance of replaced or additional work. Prepare anchor inspection reports.

E. For factory-installed glazing materials whose orientation (secure or attack side) is critical for performance, verify installation orientation.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other security window anchors whose installation is specified in other Sections.

1. Furnish cast-in-place anchors and similar devices to other trades for installation well in advance of time needed for coordinating other work.

3.3 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing security windows to in-place construction. Include threaded fasteners for inserts, security fasteners, and other connectors.

1. Install an attached or integral flange to secure side of security windows extending over rough-in opening gap so that gap has same [forced-entry-resistance] [and] [ballistics-resistance] performance as security window.

B. Voice-Communication-Type Framing: Attach removable glass spacers to jambs and head of glazing, located not more than 6 inches from each corner and spaced not more than 12 inches o.c.

C. Glazed Framing: Provide gasket-glazed framing. Comply with installation requirements in Section 08 80 00 “Glazing."

D. Removable Glazing Stops and Trim: Fasten components with security fasteners.

E. Fasteners: Install security windows using fasteners recommended by manufacturer with head style appropriate for installation requirements, strength, and finish of adjacent materials. Provide stainless-steel fasteners in stainless-steel materials.

F. Sealants: Comply with requirements in Section 079200 "Joint Sealants" for installing sealants, fillers, and gaskets.

1. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction unless otherwise indicated.
2. Seal frame perimeter with sealant to provide weathertight construction unless otherwise indicated.

G. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended in writing by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

3.4 ADJUSTING

A. Adjust horizontal-sliding, transaction security windows to provide a tight fit at contact points for smooth operation and a secure enclosure.

B. Adjust transaction drawers to provide a tight fit at contact points [and weather stripping] for smooth operation and [weathertight and] secure enclosure.

C. Remove and replace defective work, including security windows that are warped, bowed, or otherwise unacceptable.

3.5 CLEANING AND PROTECTION

A. Clean surfaces promptly after installation of security windows. Take care to avoid damaging the finish. Remove excess glazing and sealant compounds, dirt, and other substances.

1. Lubricate sliding security window hardware.
2. Lubricate transaction drawer hardware.

B. Clean glass of preglazed security windows promptly after installation. Comply with requirements in Section 08 80 00 “Glazing" for cleaning and maintenance.

C. Provide temporary protection to ensure that security windows are without damage at time of Substantial Completion.

END OF SECTION 08 56 53

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 "General Requirements" sections for Allowances, Alternates, Owner Furnished Contractor Installed, Project Management and Coordination.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:

   a. "Metal Doors and Frames"
   b. "Flush Wood Doors"
   c. "Stile and Rail Wood Doors"
   d. "Interior Aluminum Doors and Frames"
   e. "Aluminum-Framed Entrances and Storefronts"
   f. "Stainless Steel Doors and Frames"
   g. "Special Function Doors"
   h. "Entrances"

6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.3 REFERENCES

A. UL LLC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule

2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.4 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:

a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:

a. Wiring Diagrams: For power, signal, and control wiring and including:

1) Details of interface of electrified door hardware and building safety and security systems.
2) Schematic diagram of systems that interface with electrified door hardware.
3) Point-to-point wiring.
4) Risers.

3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.

a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. Door Hardware Schedule:

a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.

b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
c. Indicate complete designations of each item required for each opening, include:

1) Door Index: door number, heading number, and Architect's hardware set number.
2) Quantity, type, style, function, size, and finish of each hardware item.
3) Name and manufacturer of each item.
4) Fastenings and other pertinent information.
5) Location of each hardware set cross-referenced to indications on Drawings.
6) Explanation of all abbreviations, symbols, and codes contained in schedule.
7) Mounting locations for hardware.
8) Door and frame sizes and materials.
9) Degree of door swing and handing.
10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

5. Key Schedule:

a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
2. Provide Product Data:

a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
b. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
b. Catalog pages for each product.
c. Final approved hardware schedule edited to reflect conditions as installed.
d. Final keying schedule
e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:

a. Fire door assemblies, in compliance with NFPA 80.
b. Required egress door assemblies, in compliance with NFPA 101.

1.5 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:

   a. For door hardware: DHI certified AHC or DHC.
   b. Can provide installation and technical data to Architect and other related subcontractors.
   c. Can inspect and verify components are in working order upon completion of installation.
   d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.

4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:

   a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
   b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

2. Smoke and Draft Control Door Assemblies:

   a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
   b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

3. Electrified Door Hardware

   a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

4. Accessibility Requirements:

   a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference

a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:

1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
2) Preliminary key system schematic diagram.
3) Requirements for key control system.
4) Requirements for access control.
5) Address for delivery of keys.

2. Pre-installation Conference

a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
b. Inspect and discuss preparatory work performed by other trades.
c. Inspect and discuss electrical roughing-in for electrified door hardware.
d. Review sequence of operation for each type of electrified door hardware.
e. Review required testing, inspecting, and certifying procedures.
f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:

a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.7 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.8 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.

a. Mechanical Warranty

1) Locks

a) Schlage ND Series: 10 years

2) Exit Devices

a) Von Duprin: 10 years

3) Closers

a) LCN 4000 Series: 30 years

b. Electrical Warranty

1) Exit Devices

a) Von Duprin: 3 years

1.9 MAINTENANCE

A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."

1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.

B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.

C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.2 MATERIALS

A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer’s recognized installation standards for application intended.
2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with “Metal Doors and Frames”, “Flush Wood Doors”, “Stile and Rail Wood Doors” to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

C. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.3 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

a. Ives 5BB series

2. Acceptable Manufacturers and Products:

a. Hager BB1191/1279 series
b. Best FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:

a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:

a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. 2 inches or thicker doors:

a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
b. Interior: Heavy weight, steel, 5 inches (127 mm) high

6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

a. Steel Hinges: Steel pins
b. Non-Ferrous Hinges: Stainless steel pins
c. Out-Swinging Exterior Doors: Non-removable pins
d. Out-Swinging Interior Lockable Doors: Non-removable pins
e. Interior Non-lockable Doors: Non-rising pins

9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.4 CONTINUOUS HINGES

A. Manufacturers:

1. Scheduled Manufacturer and Product:

a. Ives 700 series

2. Acceptable Manufacturers:

a. Markar
b. Select

B. Requirements:

1. Provide pin and barrel continuous hinges conforming to ANSI/BHMA A156.26., Grade 1.
2. Provide pin and barrel continuous hinges fabricated from 14-gauge, type 304 stainless steel.
3. Provide twin self-lubricated nylon bearings at each hinge knuckle, with 0.25-inch (6 mm) diameter stainless steel pin.
4. Provide hinges capable of supporting door weights up to 600 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide pin and barrel continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide pin and barrel continuous hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.5 CONTINUOUS HINGES

A. Manufacturers:

1. Scheduled Manufacturer:

   a. Ives

2. Acceptable Manufacturers:

   a. Select
   b. Hager

B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.6 ELECTRIC POWER TRANSFER

A. Manufacturers:

1. Scheduled Manufacturer and Product:

   a. Von Duprin EPT-10

2. Acceptable Manufacturers and Products:

   a. No Substitute

B. Requirements:

1. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
2. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.7 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

   a. Schlage ND series

2. Acceptable Manufacturers and Products:

   a. No Substitute

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide escutcheon with lock status indicator window on top of lockset rose:

    a. Escutcheon height (including rose) 6.05 inches high by 3.68 inches wide.
    b. Indicator window measuring a minimum 3.52-inch by .60 inch with 1.92 square-inches of front facing viewing area and 180-degree visibility with a total of .236 square-inches of total viewable area.
    c. Provide snap-in serviceable window to prevent tampering. Lock must function if indicator is compromised.
    d. Provide messages color-coded with full text and symbol, as scheduled, for easy visibility.
    e. Unlocked and Unoccupied message will display on white background, and Locked and Occupied message will display on red background.

3. Cylinders: Refer to "KEYING" article, herein.
4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
5. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
6. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
7. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
8. Provide electrified options as scheduled in the hardware sets.
9. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.

    a. Vandlgard: Provide levers with vandal resistant technology for use at heavy traffic or abusive applications.
    b. Lever Design: <INSERT LEVER DESIGN>.

2.8 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

    a. Von Duprin 98/35A series

2. Acceptable Manufacturers and Products:

    a. No Substitute

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide smooth touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices at pool gates with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
9. Provide exit devices with manufacturers’ approved strikes.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.

12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.
17. Special Options:

    a. SI

        1) Provide dogging indicators for visible indication of dogging status.

    b. CVC

        1) Provide cable-actuated concealed vertical latch system in two-point for non-rated or fire rated wood doors up to a 90 minute rating and less bottom latch (LBL) configuration for non-rated or fire rated wood doors up to 20 minute rating. Vertical rods are not permitted.

            a) Cable: Stainless steel with abrasive resistant coating. Conduit and core wire ends snap into latch and center slides without use of tools.
            b) Wood Door Prep: Maximum 1 inch x 1.1875 inch x 3.875 inches top latch pocket and 1 inch x 1.1875 inch x 5 inches bottom latch pocket which does not require the use of a metal wrap or edge for non-rated or fire rated wood doors up to a 45 minute rating.
            c) Latchbolts and Blocking Cams: Manufactured from sintered metal low carbon copper-infiltrated steel, with molybdenum disulfide low friction coating.
            d) Top Latchbolt: Minimum 0.38 inch (10 mm) and greater than 90-degree engagement with strike to prevent door and frame separation under high static load.
            e) Bottom Latchbolt: Minimum of 0.44-inch (11 mm) engagement with strike.
            f) Product Cycle Life: 1,000,000 cycles.
            g) Latch Operation: Top and bottom latch operate independently of each other. Top latch fully engages top strike even when bottom latch is compromised. Separate trigger mechanisms not permitted.
            h) Latch release does not require separate trigger mechanism.
            i) Cable and latching system characteristics:

                i. Installed independently of exit device installation, and capable of functioning on door prior to device and trim installation.
                ii. Connected to exit device at single point in steel and aluminum doors, and two points for top and bottom latches in wood doors.
                iii. Bottom latch height adjusted, from single point for steel and aluminum doors and two points for wood doors, after system is installed and connected to exit device, while door is hanging
                iv. Bottom latch position altered up and down minimum of 2 inches (51 mm) in steel and aluminum doors without additional adjustment. Bottom latch deadlocks in every adjustment position in wood doors.
                v. Top and bottom latches in steel and aluminum doors and top latch in wood doors may be removed while door is hanging.

2.9 ELECTRIC STRIKES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

    a. Von Duprin 6000 Series

2. Acceptable Manufacturers and Products:

    a. Folger Adam 300 Series
    b. HES 1006 Series

B. Requirements:

1. Provide electric strikes designed for use with type of locks shown at each opening.
2. Provide electric strikes UL Listed as burglary resistant that are tested to a minimum endurance test of 1,000,000 cycles.
3. Where required, provide electric strikes UL Listed for fire doors and frames.
4. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.10 POWER SUPPLIES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

    a. Schlage/Von Duprin PS900 Series

2. Acceptable Manufacturers and Products:

    a. No Substitute

B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:

    a. 12/24 VDC Output, field selectable.
    b. Class 2 Rated power limited output.
    c. Universal 120-240 VAC input.
    d. Low voltage DC, regulated and filtered.
    e. Polarized connector for distribution boards.
    f. Fused primary input.
    g. AC input and DC output monitoring circuit w/LED indicators.
    h. Cover mounted AC Input indication.
    i. Tested and certified to meet UL294.
    j. NEMA 1 enclosure.
    k. Hinged cover w/lock down screws.
    l. High voltage protective cover.

2.11 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer and Product:

    a. Schlage Primus Everest exterior / Schlage Everest D interior

2. Acceptable Manufacturers and Products:

a. No Substitute

B. Requirements:

1. Provide cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

2.12 KEYING

A. Scheduled System:

1. Existing factory registered system:

a. Provide cylinders/cores keyed into Owner's existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Construction Keying:

a. Replaceable Construction Cores.

1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.

a) 3 construction control keys
b) 12 construction change (day) keys.

2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.

2. Permanent Keying:

a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.

1) Master Keying system as directed by the Owner.

b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.

c. Provide keys with the following features:

1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
2) Patent Protection: Keys and blanks protected by one or more utility patent(s).

d. Identification:

1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
2) Identification stamping provisions must be approved by the Architect and Owner.
3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.

e. Quantity: Furnish in the following quantities.

1) Permanent Control Keys: 3.
2) Master Keys: 6.
3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
4) Key Blanks: Quantity as determined in the keying meeting.

2.13 KEY MANAGEMENT SOFTWARE

A. Requirements

1. Provide training and onboarding, including:

a. Connecting Overtur to the factory master key software, enabling real time visibility of key system data.

2.14 KEY CONTROL SYSTEM

A. Manufacturers:

1. Scheduled Manufacturer:

a. Telkee

2. Acceptable Manufacturers:

a. HPC
b. Lund

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.

a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
b. Provide hinged-panel type cabinet for wall mounting.

2.15 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

a. LCN 4010/4110/4020 series

2. Acceptable Manufacturers and Products:

a. No Substitute

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. Certify surface mounted mechanical closers to meet fifteen million (15,000,000) full load cycles. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.

3. Cylinder Body: 1-1/2-inch (38 mm) diameter with 11/16-inch (17 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers. When closers are parallel arm mounted, provide closers which mount within 6-inch (152 mm) top rail without use of mounting plate so that closer is not visible through vision panel from pull side.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI/BHMA Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.16 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Burns
b. Trimco

B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.17 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Burns
b. Trimco

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.18 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:

a. Glynn-Johnson

2. Acceptable Manufacturers:

a. No Substitute

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.19 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Burns
b. Trimco

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.20 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Rockwood
b. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.21 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Scheduled Manufacturer:

1. Zero International

B. Acceptable Manufacturers:

1. National Guard
2. Reese
3. Pemko
4. Legacy

C. Seals and Gasketing: Provide continuous gasketing on exterior openings, to the head and jambs, forming a continuous seal between the door and the frame. Provide smoke, light, or sound gasketing on interior doors where indicated.

1. Provide self-tapping fasteners for aluminum extruded gasketing being applied to hollow metal frames.

   a. Provide non-corrosive fasteners for all exterior applications.
   b. Provide security fasteners where indicated.

2. Provide neoprene, EPDM, silicone, or nylon brush inserts as specified in hardware sets. Provide non brush inserts of solid or sponge cell, as specified in hardware sets. Vinyl inserts are not allowed except where specified in hardware sets.

D. Smoke Labeled Gasketing: At all smoke labeled openings, provide smoke listed perimeter gasketing assemblies complying with NFPA 105 listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for smoke control ratings indicated based on testing according to UL 1784.

E. Fire Listed Gasketing: Assemblies complying with NFPA 80 that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction for fire ratings indicated based on testing according to UL-10C.

1. Where frame-applied intumescent seals are required by the manufacturer, provide gaskets that comply with UL10C Standard for Positive Pressure Fire Tests of Door Assemblies and UBC 7-2, Fire Tests of Door Assemblies.

F. Sound-Rated Gasketing: Provide acoustic gasketing to meet Sound Transmission Class (STC) rating required.

G. Meeting-Stile Gasketing: Provide meeting-stile gasketing that fastens to the meeting stiles forming a continuous seal when doors are closed.

H. Door Sweeps or Shoes: Apply to the bottom of the door to close the gap between the door bottom and finished floor or saddle threshold.

1. Provide solid neoprene, EPDM, silicone, or nylon brush type of seal as specified in hardware sets. Vinyl inserts are not allowed except where specified in hardware sets.

I. Automatic Door Bottoms:

1. Provide closed cell sponge, bulb neoprene. or EPDM type of seal as specified in hardware sets.
2. Door bottom to be mortised, semi mortised, or surface mount as with a minimum thickness as specified in hardware sets.

J. Rain Drips:

1. Provide overhead rain drips for out-swinging hollow metal doors that are not covered against 45 degree blowing rain. Aluminum extrusion to be a minimum of .088 inches thick and extend 2.50 inches from the face of the frame, in anodized finish to match door.
2. Door sweeps or shoes with integral rain drip must meet ADA requirements

K. Thresholds: Provide threshold units not less than 4 inches wide, formed to accommodate change in floor elevation where indicated, and fabricated to accommodate door hardware and fit door frames.

1. Threshold extrusion to be a minimum thickness as specified in hardware sets.

2.22 ROLLER LATCHES

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Burns
b. Trimco
c. Rockwood

B. Requirements:

1. Provide roller latches with 4-7/8 inches (124 mm) strike at single doors to fit ANSI frame prep. If dummy levers are used in conjunction with roller latch mount roller latch at a height as to not interfere with proper mounting and height of dummy lever.
2. Provide roller latches with 2-1/4 inches (57 mm) full lip strike at pair doors. Mount roller in top rail of each leaf per manufacturer's template.

2.23 FINISHES

A. FINISH: BHMA 626/652 (US26D); EXCEPT:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. Thresholds: Mill Finish Aluminum

B. FINISH: BHMA 643E/716 (US11); EXCEPT:

1. Door Closers: Powder Coat to Match.
2. Weatherstripping: Dark Bronze Anodized Aluminum.
3. Thresholds: Extruded Architectural Bronze, Oil-Rubbed

C. FINISH: BHMA 605/632 (US3); EXCEPT:

1. Door Closers: Powder Coat to Match
2. Latch Protectors: BHMA 630 (US32D)
3. Weatherstripping: Gold Anodized Aluminum.
4. Thresholds: Mill Finish Gold

D. FINISH: BHMA 630 (US32D); EXCEPT:

1. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
2. Door Closers: Powder Coat to Match
3. Weatherstripping: Clear Anodized Aluminum

4. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
4. Installation Guide for Doors and Hardware: DHI TDH-007-20

B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.

C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

I. Lock Cylinders:

1. Install construction cores to secure building and areas during construction period.
2. Replace construction cores with permanent cores as indicated in keying section.
3. Furnish permanent cores to Owner for installation.

J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.

4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Connections to panel interface modules, controllers, and gateways.
6. Testing and labeling wires with Architect's opening number.

K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

L. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.

M. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

N. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

P. Thresholds:

1. Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
2. Aluminum thresholds to be cut-in, and scribed around mullions, frame members, and stops. Do not butt to thresholds. Provide a continuous surface across full width of opening from jamb to jamb.
3. Where aluminum panic-type (rabbeted) thresholds with neoprene inserts are specified, undercut doors as required to properly mate with seal in threshold.

Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

R. Perimeter Gasketing:

1. Apply to head and jamb, forming seal between door and frame.
2. Install gasketing in a manner eliminating need to cut any seal to install surface mounted hardware. Install compatible mounting bracket for surface mounted hardware unless minimum 1/4 inch thick solid aluminum seals are provided for mounting of surface applied hardware.

S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

T. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.3 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.
2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.4 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer's instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.5 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

Hardware Group No. 01A

For use on Door #(s):
006.1 008.1 017.1 020.1 026.2

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	605	IVE
1	EA	STOREROOM LOCK	ND80TD ATH	605	SCH
1	EA	PRIMUS CORE	20-740-XP CKC EV D	606	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	DOOR SWEEP	8197AA	AA	ZER
1	EA	THRESHOLD	566A-223	A	ZER
1	EA	DOOR POSITION SWITCH	195-12W	DKB	GEO

DOOR OPERATION:
DOOR CONTACT MONITORED BY DIVISION 28

Hardware Group No. 01B

For use on Door #(s):
100.1 C10

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY EPT	628	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB	689	VON
1	EA	ELEC PANIC HARDWARE	LD-RX-98-EO-CON	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-NL-OP-110MD 24 VDC	626	VON
1	EA	RIM CYLINDER	20-057 ICX	626	SCH
1	EA	MORTISE CYLINDER	20-061 ICX	626	SCH
2	EA	PRIMUS CORE	20-740-XP CKC EV D	626	SCH
1	EA	90 DEG OFFSET PULL	8190EZHD 12" O	630-316	IVE
2	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
2	EA	CUSH SHOE SUPPORT	4110-30 SRT	689	LCN
2	EA	BLADE STOP SPACER	4110-61 SRT	689	LCN
2	EA	DOOR SWEEP	8197AA	AA	ZER
1	EA	THRESHOLD	566A-223	A	ZER
2	EA	WIRE HARNESS	CON-P (LENGTH AS REQUIRED)		VON
2	EA	WIRE HARNESS	CON-6W		VON
1	EA	CREDENTIAL READER	FURNISHED BY DIVISION 28		B/O
2	EA	DOOR POSITION SWITCH	195-12W	DKB	GEO
1	EA	POWER SUPPLY	PS902 900-2RS KL900 120/240 VAC	LGR	SCE

DOOR OPERATION:
DOOR NORMALLY CLOSED AND LOCKED
ENTRY BY VALID CARD CREDENTIAL OR KEY OVERRIDE
FREE EGRESS FROM INSIDE AT ALL TIMES
DOOR CONTACT AND REQUEST TO EXIT MONITORED BY DIVISION 28

Hardware Group No. 01C

For use on Door #(s):
ST-3.2

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	700 (CUSTOM PAINT BRASS)	630	IVE
1	EA	PANIC HARDWARE	LD-98-EO	605	VON
1	EA	SURFACE CLOSER	4111 SCUSH	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	DOOR SWEEP	8197AA	AA	ZER
1	EA	THRESHOLD	566A-223	A	ZER
1	EA	DOOR POSITION SWITCH	195-12W	DKB	GEO

DOOR OPERATION:
DOOR CONTACT MONITORED BY DIVISION 28

Hardware Group No. 01D

For use on Door #(s):
ST-2.2

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	700 EPT (CUSTOM PAINT BRASS)	630	IVE
1	EA	POWER TRANSFER	EPT10 CON	695	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-NL-OP-110MD 24 VDC	605	VON
1	EA	RIM CYLINDER	20-057 ICX	605	SCH
1	EA	PRIMUS CORE	20-740-XP CKC EV D	606	SCH
1	EA	90 DEG OFFSET PULL	8190EZHD 12" O	605	IVE
1	EA	SURFACE CLOSER	4111 SCUSH	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	DOOR SWEEP	8197AA	AA	ZER
1	EA	THRESHOLD	566A-223	A	ZER
1	EA	WIRE HARNESS	CON-P (LENGTH AS REQUIRED)		VON
1	EA	WIRE HARNESS	CON-6W		VON
1	EA	CREDENTIAL READER	FURNISHED BY DIVISION 28		B/O
1	EA	DOOR POSITION SWITCH	195-12W	DKB	GEO
1	EA	POWER SUPPLY	PS902 900-2RS KL900 120/240 VAC	LGR	SCE

DOOR OPERATION:
DOOR NORMALLY CLOSED AND LOCKED
ENTRY BY VALID CARD CREDENTIAL OR KEY OVERRIDE
FREE EGRESS FROM INSIDE AT ALL TIMES
DOOR CONTACT AND REQUEST TO EXIT MONITORED BY DIVISION 28

Hardware Group No. 01E

For use on Door #(s):
108.3

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	700 (CUSTOM PAINT BRASS)	630	IVE
1	EA	PANIC HARDWARE	LD-98-EO	605	VON
1	EA	SURFACE CLOSER	4111 SCUSH	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	DOOR SWEEP	8197AA	AA	ZER
1	EA	THRESHOLD	566A-223	A	ZER
1	EA	DOOR POSITION SWITCH	195-12W	DKB	GEO

DOOR OPERATION:
DOOR CONTACT MONITORED BY DIVISION 28

Hardware Group No. 01F

For use on Door #(s):
ST-1.3

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	605	IVE
2	EA	PANIC HARDWARE	LD-98-EO	605	VON
2	EA	SURFACE CLOSER	4111 SCUSH	696	LCN
2	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
2	EA	DOOR SWEEP	8197AA	AA	ZER
1	EA	THRESHOLD	566A-223	A	ZER

NOTE:
EXISTING DOOR AND FRAME TO REMAIN
VERIFY EXISTING DOOR AND FRAME PREPS FOR COMPATIBILITY OF SPECIFIED HARDWARE
VERIFY EXISTING HINGES, LOCK STRIKE PREP AND FURNISH REQUIRED STRIKE TO FIT.
PRIOR TO ORDERING NOTIFY ARCHITECT OF ANY REQUIRED CHANGES

Hardware Group No. 01G

For use on Door #(s):
ST-1.2

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	605	IVE
1	EA	PANIC HARDWARE	LD-98-EO	605	VON
1	EA	SURFACE CLOSER	4111 SCUSH	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	DOOR SWEEP	8197AA	AA	ZER
1	EA	THRESHOLD	566A-223	A	ZER

NOTE:
EXISTING DOOR AND FRAME TO REMAIN
VERIFY EXISTING DOOR AND FRAME PREPS FOR COMPATIBILITY OF SPECIFIED HARDWARE
VERIFY EXISTING HINGES, LOCK STRIKE PREP AND FURNISH REQUIRED STRIKE TO FIT.
PRIOR TO ORDERING NOTIFY ARCHITECT OF ANY REQUIRED CHANGES

Hardware Group No. 01H

For use on Door #(s):
100.2

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY EPT	628	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB	689	VON
1	EA	ELEC PANIC HARDWARE	LD-RX-98-EO-CON	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-NL-OP-110MD 24 VDC	626	VON
1	EA	RIM CYLINDER	20-057 ICX	626	SCH
1	EA	MORTISE CYLINDER	20-061 ICX	626	SCH
2	EA	PRIMUS CORE	20-740-XP CKC EV D	626	SCH
1	EA	90 DEG OFFSET PULL	8190EZHD 12" O	630-316	IVE
2	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
2	EA	CUSH SHOE SUPPORT	4110-30 SRT	689	LCN
2	EA	BLADE STOP SPACER	4110-61 SRT	689	LCN
2	EA	WIRE HARNESS	CON-P (LENGTH AS REQUIRED)		VON
2	EA	WIRE HARNESS	CON-6W		VON
1	EA	CREDENTIAL READER	FURNISHED BY DIVISION 28		B/O
2	EA	DOOR POSITION SWITCH	195-12W	DKB	GEO
1	EA	POWER SUPPLY	PS902 900-2RS KL900 120/240 VAC	LGR	SCE

DOOR OPERATION:
DOOR NORMALLY CLOSED AND LOCKED
ENTRY BY VALID CARD CREDENTIAL OR KEY OVERRIDE
FREE EGRESS FROM INSIDE AT ALL TIMES
DOOR CONTACT AND REQUEST TO EXIT MONITORED BY DIVISION 28

Hardware Group No. 02A

For use on Door #(s):
ST-1.4 ST-2.3 ST-3.1

Provide each UEP door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5	632	IVE
1	EA	FIRE EXIT HARDWARE	9849-EO-F-LBLAFL	605	VON
1	EA	FIRE EXIT HARDWARE	9849-L-BE-F-07-LBL	605	VON
2	EA	SURFACE CLOSER	4111 CUSH	696	LCN
2	EA	KICK PLATE	8400 8" X 1" LDW B-CS	605	IVE
1	EA	GASKETING	8150SBK PSA	BK	ZER
1	EA	WEATHERSTRIPPING	8217SBK PSA	BK	ZER

NOTE:
EXISTING FRAME TO REMAIN
VERIFY EXISTING DOOR AND FRAME PREPS FOR COMPATIBILITY OF SPECIFIED HARDWARE
PRIOR TO ORDERING NOTIFY ARCHITECT OF ANY REQUIRED CHANGES TO SPECIFIED HARDWARE BASED ON EXISTING CONDITONS

Hardware Group No. 02B

For use on Door #(s):
ST-3.3

Provide each UEP door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5	632	IVE
1	EA	FIRE EXIT HARDWARE	9849-EO-F-LBLAFL	605	VON
1	EA	FIRE EXIT HARDWARE	9849-L-BE-F-07-LBL	605	VON
2	EA	SURFACE CLOSER	4111 CUSH	696	LCN
2	EA	KICK PLATE	8400 8" X 1" LDW B-CS	605	IVE
1	EA	GASKETING	8150SBK PSA	BK	ZER
1	EA	WEATHERSTRIPPING	8217SBK PSA	BK	ZER

NOTE:
EXISTING FRAME TO REMAIN
VERIFY EXISTING DOOR AND FRAME PREPS FOR COMPATIBILITY OF SPECIFIED HARDWARE
PRIOR TO ORDERING NOTIFY ARCHITECT OF ANY REQUIRED CHANGES TO SPECIFIED HARDWARE BASED ON EXISTING CONDITONS

Hardware Group No. 02C

For use on Door #(s):
ST-1.1 ST-1.5

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	632	IVE
1	EA	DOOR CORD	DC-HD-16	630	LOC
1	EA	ELEC FIRE EXIT HARDWARE	RX-98-L-BE-F-M996-07-FS-CON	605	VON
1	EA	SURFACE CLOSER	4111 EDA	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	WALL STOP	WS406/407CCV	605	IVE
1	EA	WIRE HARNESS	CON-P (LENGTH AS REQUIRED)		VON
1	EA	WIRE HARNESS	CON-6W		VON
1	EA	CREDENTIAL READER	FURNISHED BY DIVISION 28		B/O
1	EA	DOOR POSITION SWITCH	195-12W	DKB	GEO
1	EA	POWER SUPPLY	PS902 900-2RS KL900 120/240 VAC	LGR	SCE

NOTE:
EXISTING FRAME TO REMAIN
VERIFY EXISTING DOOR AND FRAME PREPS FOR COMPATIBILITY OF SPECIFIED HARDWARE
PRIOR TO ORDERING NOTIFY ARCHITECT OF ANY REQUIRED CHANGES TO SPECIFIED HARDWARE BASED ON EXISTING CONDITONS

DOOR OPERATION:
DOOR NORMALLY CLOSED AND SECURE FROM THE STAIR SIDE OF DOOR.
LEVER TRIM HELD IN LOCKED POSITION BY SIGNAL FROM FIRE ALARM AND WILL RELEASE UPON FIRE ALARM ACTIVATION FOR IMMEDIATE ACCESS TO FLOOR.
AUTHORIZED ENTRY ONTO FLOOR BY VALID CREDENTIAL OR MECHANICAL KEY OVERRIDE.
DOOR CONTACT AND REQUEST TO EXIT MONITORED BY DIVISION 28
FREE EGRESS FROM THE PUSH SIDE OF DOOR AT ALL TIMES.

Hardware Group No. 02D

For use on Door #(s):
ST-2.4 ST-3.4

Provide each UEP door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5	632	IVE
1	EA	FIRE EXIT HARDWARE	9849-EO-F-LBLAFL	605	VON
1	EA	FIRE EXIT HARDWARE	9849-L-BE-F-07-LBL	605	VON
2	EA	SURFACE CLOSER	4111 CUSH	696	LCN
2	EA	KICK PLATE	8400 8" X 1" LDW B-CS	605	IVE
1	EA	GASKETING	8150SBK PSA	BK	ZER
1	EA	WEATHERSTRIPPING	8217SBK PSA	BK	ZER

NOTE:
EXISTING FRAME TO REMAIN
VERIFY EXISTING DOOR AND FRAME PREPS FOR COMPATIBILITY OF SPECIFIED HARDWARE
PRIOR TO ORDERING NOTIFY ARCHITECT OF ANY REQUIRED CHANGES TO SPECIFIED HARDWARE BASED ON EXISTING CONDITONS

Hardware Group No. 02E

For use on Door #(s):
ST-2.1

Provide each SGL door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR

Hardware Group No. 02F

For use on Door #(s):
C08

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	632	IVE
1	EA	PANIC HARDWARE	98-L-BE-07	605	VON
1	EA	SURFACE CLOSER	4111 CUSH	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

Hardware Group No. 02G

For use on Door #(s):
101 C12

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-98-NL-OP-110MD 24 VDC	626	VON
1	EA	RIM CYLINDER	20-057 ICX	626	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	90 DEG OFFSET PULL	8190EZHD 12" O	630-316	IVE
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	CUSH SHOE SUPPORT	4110-30 SRT	689	LCN
1	EA	BLADE STOP SPACER	4110-61 SRT	689	LCN
1	EA	WIRE HARNESS	CON-P (LENGTH AS REQUIRED)		VON
1	EA	WIRE HARNESS	CON-6W		VON
1	EA	CREDENTIAL READER	FURNISHED BY DIVISION 28		B/O
1	EA	DOOR POSITION SWITCH	195-12W	DKB	GEO
1	EA	POWER SUPPLY	PS902 900-2RS KL900 120/240 VAC	LGR	SCE

NOTE:
EXISTING FRAME TO REMAIN
VERIFY EXISTING DOOR AND FRAME PREPS FOR COMPATIBILITY OF SPECIFIED HARDWARE
PRIOR TO ORDERING NOTIFY ARCHITECT OF ANY REQUIRED CHANGES TO SPECIFIED HARDWARE BASED ON EXISTING CONDITONS

DOOR OPERATION:
DOOR NORMALLY CLOSED AND LOCKED
ENTRY BY VALID CARD CREDENTIAL OR KEY OVERRIDE
FREE EGRESS FROM INSIDE AT ALL TIMES
DOOR CONTACT AND REQUEST TO EXIT MONITORED BY DIVISION 28

Hardware Group No. 03A

For use on Door #(s):
007.1 111 204.1 206 210.1 212.1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	632	IVE
1	EA	PASSAGE SET	ND10S ATH	605	SCH
1	EA	WALL STOP	WS406/407CCV	605	IVE
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

Hardware Group No. 03B

For use on Door #(s):
203.1 212.2

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	632	IVE
1	EA	PASSAGE SET	ND10S ATH	605	SCH
1	EA	WRAP AROUND RETRO PLATE	4-2-CW	605	DON
1	EA	CUSTOM LOCK STRIKE	AS REQUIRED	605	
1	EA	WALL STOP	WS406/407CCV	605	IVE
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

NOTE:
EXISTING DOOR AND FRAME TO REMAIN
VERIFY EXISTING DOOR AND FRAME PREPS FOR COMPATIBILITY OF SPECIFIED HARDWARE
VERIFY EXISTING HINGES, LOCK STRIKE PREP AND FURNISH REQUIRED STRIKE TO FIT.
GC TO PATCH EXISTING HOLES AND PROVIDE BLOCKING FOR EXISTING LOCK PREP

Hardware Group No. 04A

For use on Door #(s):

004	006	007	008	011	017
018	019	020	109	110	112
113	116.2	116.3	116.4	116.5	202.2
202.3	202.4	202.5	202.6	205.2	205.3
209.1	209.2	209.3	210.2		

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	632	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50TD ATH	605	SCH
1	EA	FSIC CORE	23-030 EV D	606	SCH
1	EA	WALL STOP	WS406/407CCV	605	IVE
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

Hardware Group No. 04B

For use on Door #(s):
115.1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	632	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50TD ATH	605	SCH
1	EA	FSIC CORE	23-030 EV D	606	SCH
1	EA	WALL STOP	WS406/407CCV	605	IVE
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

Hardware Group No. 04C

For use on Door #(s):

116-1	116-2	203	205	210	211-1
211-2					

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	632	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50TD ATH	605	SCH
1	EA	FSIC CORE	23-030 EV D	606	SCH
1	EA	SURFACE CLOSER	4111 HCUSH	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

Hardware Group No. 04D - Not Used

Hardware Group No. 04E

For use on Door #(s):

023	114.1	115.2	115.4	115.5	210.3
211.1	211.2	211.4	211.5		

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	632	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50TD ATH	605	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	WRAP AROUND RETRO PLATE	4-2-CW	605	DON
1	EA	CUSTOM LOCK STRIKE	AS REQUIRED	605	
1	EA	WALL STOP	WS406/407CCV	605	IVE

NOTE:
EXISTING DOOR AND FRAME TO REMAIN
VERIFY EXISTING DOOR AND FRAME PREPS FOR COMPATIBILITY OF SPECIFIED HARDWARE
VERIFY EXISTING HINGES, LOCK STRIKE PREP AND FURNISH REQUIRED STRIKE TO FIT.
GC TO PATCH EXISTING HOLES AND PROVIDE BLOCKING FOR EXISTING LOCK PREP

Hardware Group No. 04F

For use on Door #(s):
115 202 209-2 209

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	632	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50TD ATH	605	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	WRAP AROUND RETRO PLATE	4-2-CW	605	DON
1	EA	CUSTOM LOCK STRIKE	AS REQUIRED	605	
1	EA	SURFACE CLOSER	4111 HCUSH	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

NOTE:
EXISTING DOOR AND FRAME TO REMAIN
VERIFY EXISTING DOOR AND FRAME PREPS FOR COMPATIBILITY OF SPECIFIED HARDWARE
VERIFY EXISTING HINGES, LOCK STRIKE PREP AND FURNISH REQUIRED STRIKE TO FIT.
GC TO PATCH EXISTING HOLES AND PROVIDE BLOCKING FOR EXISTING LOCK PREP

Hardware Group No. 04G

For use on Door #(s):
104 106

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	F643E/716	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50TD ATH	643e	SCH
1	EA	WRAP AROUND RETRO PLATE	4-2-CW	643e	DON
1	EA	CUSTOM LOCK STRIKE	AS REQUIRED	643e	
1	EA	SURFACE CLOSER	4111 EDA	695	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	695	IVE
3	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

Hardware Group No. 05A

For use on Door #(s):
208

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	632	IVE
1	EA	CLASSROOM LOCK	ND70TD ATH	605	SCH
1	EA	FSIC CORE	23-030 EV D	606	SCH
1	EA	WALL STOP	WS406/407CCV	605	IVE
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

Hardware Group No. 05B

For use on Door #(s):
205.1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	632	IVE
1	EA	CLASSROOM LOCK	ND70TD ATH	605	SCH
1	EA	FSIC CORE	23-030 EV D	606	SCH
1	EA	WALL STOP	WS406/407CCV	605	IVE
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

Hardware Group No. 05C

For use on Door #(s):
205.4

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	632	IVE
1	EA	CLASSROOM LOCK	ND70TD ATH	605	SCH
1	EA	FSIC CORE	23-030 EV D	606	SCH
1	EA	OH STOP	410S	605	GLY
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

Hardware Group No. 05D

For use on Door #(s):
027.1 027.2

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	632	IVE
1	EA	CLASSROOM LOCK	ND70TD ATH	605	SCH
1	EA	FSIC CORE	23-030 EV D	606	SCH
1	EA	WRAP AROUND RETRO PLATE	4-2-CW	605	DON
1	EA	CUSTOM LOCK STRIKE	AS REQUIRED	605	
1	EA	SURFACE CLOSER	4011	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE

NOTE:
EXISTING DOOR AND FRAME TO REMAIN
VERIFY EXISTING DOOR AND FRAME PREPS FOR COMPATIBILITY OF SPECIFIED HARDWARE
VERIFY EXISTING HINGES, LOCK STRIKE PREP AND FURNISH REQUIRED STRIKE TO FIT.
GC TO PATCH EXISTING HOLES AND PROVIDE BLOCKING FOR EXISTING LOCK PREP

Hardware Group No. 06A

For use on Door #(s):
002 207.1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	605	IVE
1	EA	STOREROOM LOCK	ND80TD ATH	605	SCH
1	EA	FSIC CORE	23-030 EV D	606	SCH
1	EA	SURFACE CLOSER	4111 HCUSH	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

Hardware Group No. 06B

For use on Door #(s):
030 033 003

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	605	IVE
1	EA	STOREROOM LOCK	ND80TD ATH	605	SCH
1	EA	FSIC CORE	23-030 EV D	606	SCH
1	EA	SURFACE CLOSER	4111 CUSH	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

Hardware Group No. 06C

For use on Door #(s):
021

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	605	IVE
1	EA	STOREROOM LOCK	ND80TD ATH	605	SCH
1	EA	FSIC CORE	23-030 EV D	606	SCH
1	EA	SURFACE CLOSER	4111 EDA	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	WALL STOP	WS406/407CCV	605	IVE
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

Hardware Group No. 06D

For use on Door #(s):
010 012 013 034

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	632	IVE
1	EA	STOREROOM LOCK	ND80TD ATH	605	SCH
1	EA	FSIC CORE	23-030 EV D	606	SCH
1	EA	SURFACE CLOSER	4011	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	WALL STOP	WS406/407CCV	605	IVE
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

Hardware Group No. 06E

For use on Door #(s):
005.1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	632	IVE
1	EA	STOREROOM LOCK	ND80TD ATH	605	SCH
1	EA	FSIC CORE	23-030 EV D	606	SCH
1	EA	WALL STOP	WS406/407CCV	605	IVE
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

Hardware Group No. 06F

For use on Door #(s):
025 026.1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	605	IVE
1	EA	STOREROOM LOCK	ND80TD ATH	605	SCH
1	EA	FSIC CORE	23-030 EV D	606	SCH
1	EA	SURFACE CLOSER	4111 CUSH	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	GASKETING	8150SBK PSA	BK	ZER

NOTE:
EXISTING FRAME TO REMAIN
VERIFY EXISTING DOOR AND FRAME PREPS FOR COMPATIBILITY OF SPECIFIED HARDWARE
PRIOR TO ORDERING NOTIFY ARCHITECT OF ANY REQUIRED CHANGES TO SPECIFIED HARDWARE BASED ON EXISTING CONDITONS

Hardware Group No. 06J

For use on Door #(s):
032

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	632	IVE
1	EA	STOREROOM LOCK	ND80TD ATH	605	SCH
1	EA	FSIC CORE	23-030 EV D	606	SCH
1	EA	SURFACE CLOSER	4111 CUSH	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

NOTE:
EXISTING DOOR AND FRAME TO REMAIN
VERIFY EXISTING DOOR AND FRAME PREPS FOR COMPATIBILITY OF SPECIFIED HARDWARE
VERIFY EXISTING HINGES, LOCK STRIKE PREP AND FURNISH REQUIRED STRIKE TO FIT.
GC TO PATCH EXISTING HOLES AND PROVIDE BLOCKING FOR EXISTING LOCK PREP

Hardware Group No. 06K

For use on Door #(s):
115.3 C13.1.1 C13.1.2

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	632	IVE
1	EA	STOREROOM LOCK	ND80TD ATH	605	SCH
1	EA	WRAP AROUND RETRO PLATE	4-2-CW	605	DON
1	EA	CUSTOM LOCK STRIKE	AS REQUIRED	605	
3	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

NOTE:
EXISTING DOOR AND FRAME TO REMAIN
VERIFY EXISTING DOOR AND FRAME PREPS FOR COMPATIBILITY OF SPECIFIED HARDWARE
VERIFY EXISTING HINGES, LOCK STRIKE PREP AND FURNISH REQUIRED STRIKE TO FIT.
GC TO PATCH EXISTING HOLES AND PROVIDE BLOCKING FOR EXISTING LOCK PREP

Hardware Group No. 07A

For use on Door #(s):
T001 T002 T100 T101

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	632	IVE
1	EA	PUSH PLATE	8200 4" X 16"	605	IVE
1	EA	PULL PLATE	8302 10" 4" X 16"	605	IVE
1	EA	SURFACE CLOSER	4011	696	LCN
1	EA	MOUNTING PLATE	4010-18	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	WALL STOP	WS406/407CCV	605	IVE
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

NOTE:
EXISTING DOOR AND FRAME TO REMAIN
VERIFY EXISTING DOOR AND FRAME PREPS FOR COMPATIBILITY OF SPECIFIED HARDWARE
VERIFY EXISTING HINGES, LOCK STRIKE PREP AND FURNISH REQUIRED STRIKE TO FIT.
PRIOR TO ORDERING NOTIFY ARCHITECT OF ANY REQUIRED CHANGES

Hardware Group No. 07B

For use on Door #(s):
T-201

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	632	IVE
1	EA	PUSH PLATE	8200 4" X 16"	605	IVE
1	EA	PULL PLATE	8302 10" 4" X 16"	605	IVE
1	EA	SURFACE CLOSER	4111 EDA	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	WALL STOP	WS406/407CCV	605	IVE
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

NOTE:
EXISTING DOOR AND FRAME TO REMAIN
VERIFY EXISTING DOOR AND FRAME PREPS FOR COMPATIBILITY OF SPECIFIED HARDWARE
VERIFY EXISTING HINGES, LOCK STRIKE PREP AND FURNISH REQUIRED STRIKE TO FIT.
PRIOR TO ORDERING NOTIFY ARCHITECT OF ANY REQUIRED CHANGES

Hardware Group No. 07C

For use on Door #(s):
T-200

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	632	IVE
1	EA	PUSH PLATE	8200 4" X 16"	605	IVE
1	EA	PULL PLATE	8302 10" 4" X 16"	605	IVE
1	EA	SURFACE CLOSER	4111 EDA	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	WALL STOP	WS406/407CCV	605	IVE
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

Hardware Group No. 08A

For use on Door #(s):
102.1 201

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	632	IVE
1	EA	STOREROOM LOCK	ND80TD ATH	605	SCH
1	EA	FSIC CORE	23-030 EV D	606	SCH
1	EA	ELECTRIC STRIKE	6400 FSE 12/24 VAC/VDC	630	VON
1	EA	SURFACE CLOSER	4011	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	WALL STOP	WS406/407CCV	605	IVE
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE
1	EA	WIRE HARNESS	CON-6W		VON
1	EA	CREDENTIAL READER	FURNISHED BY DIVISION 28		B/O
1	EA	DOOR POSITION SWITCH	195-12W	DKB	GEO
1	EA	POWER SUPPLY	PS902 900-2RS KL900 120/240 VAC	LGR	SCE

DOOR OPERATION:
DOOR NORMALLY CLOSED AND LOCKED
ENTRY BY VALID CARD CREDENTIAL OR KEY OVERRIDE
FREE EGRESS FROM INSIDE AT ALL TIMES
DOOR CONTACT MONITORED BY DIVISION 28

Hardware Group No. 08B

For use on Door #(s):
114.2

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	632	IVE
1	EA	STOREROOM LOCK	ND80TD ATH	605	SCH
1	EA	FSIC CORE	23-030 EV D	606	SCH
1	EA	ELECTRIC STRIKE	6400 FSE 12/24 VAC/VDC	630	VON
1	EA	SURFACE CLOSER	4111 CUSH	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	WALL STOP	WS406/407CCV	605	IVE
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE
1	EA	WIRE HARNESS	CON-6W		VON
1	EA	CREDENTIAL READER	FURNISHED BY DIVISION 28		B/O
1	EA	DOOR POSITION SWITCH	195-12W	DKB	GEO
1	EA	POWER SUPPLY	PS902 900-2RS KL900 120/240 VAC	LGR	SCE

DOOR OPERATION:
DOOR NORMALLY CLOSED AND LOCKED
ENTRY BY VALID CARD CREDENTIAL OR KEY OVERRIDE
FREE EGRESS FROM INSIDE AT ALL TIMES
DOOR CONTACT MONITORED BY DIVISION 28

Hardware Group No. 09A

For use on Door #(s):
015 028

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	632	IVE
1	EA	PANIC HARDWARE	98-L-NL-07	605	VON
1	EA	RIM CYLINDER	20-057 ICX	605	SCH
1	EA	FSIC CORE	23-030 EV D	606	SCH
1	EA	SURFACE CLOSER	4111 CUSH	696	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	605	IVE
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

Hardware Group No. 10A

For use on Door #(s):

116.6	116.7	116.8	116.9	211.6	211.7
211.8					

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	632	IVE
1	EA	ROLLER LATCH	RL32	605	IVE
1	EA	SINGLE DUMMY TRIM	ND170 ATH	605	SCH
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

NOTE:
EXISTING DOOR AND FRAME TO REMAIN
VERIFY EXISTING DOOR AND FRAME PREPS FOR COMPATIBILITY OF SPECIFIED HARDWARE
VERIFY EXISTING HINGES, LOCK STRIKE PREP AND FURNISH REQUIRED STRIKE TO FIT.
PRIOR TO ORDERING NOTIFY ARCHITECT OF ANY REQUIRED CHANGES

Hardware Group No. 10B

For use on Door #(s):

104.1	106.1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	F643E/716	IVE
1	EA	ROLLER LATCH	RL32	643E/716	IVE
1	EA	SINGLE DUMMY TRIM	ND170 ATH	643e	SCH
1	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

NOTE:
EXISTING DOOR AND FRAME TO REMAIN
VERIFY EXISTING DOOR AND FRAME PREPS FOR COMPATIBILITY OF SPECIFIED HARDWARE
VERIFY EXISTING HINGES, LOCK STRIKE PREP AND FURNISH REQUIRED STRIKE TO FIT.
PRIOR TO ORDERING NOTIFY ARCHITECT OF ANY REQUIRED CHANGES

Hardware Group No. 10C

For use on Door #(s):
001

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5	632	IVE
2	EA	ROLLER LATCH	RL32	605	IVE
2	EA	SINGLE DUMMY TRIM	ND170 ATH	605	SCH
2	EA	WALL STOP	WS406/407CCV	605	IVE
2	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

NOTE:
EXISTING DOOR AND FRAME TO REMAIN
VERIFY EXISTING DOOR AND FRAME PREPS FOR COMPATIBILITY OF SPECIFIED HARDWARE
VERIFY EXISTING HINGES, LOCK STRIKE PREP AND FURNISH REQUIRED STRIKE TO FIT.
PRIOR TO ORDERING NOTIFY ARCHITECT OF ANY REQUIRED CHANGES

Hardware Group No. 11A

For use on Door #(s):
108.1 108.2

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5	F643E/716	IVE
2	EA	PUSH PLATE	8200 4" X 16"	695	IVE
2	EA	PULL PLATE	8302 10" 4" X 16"	643E/716	IVE
2	EA	SURFACE CLOSER	4111 HCUSH	695	LCN
2	EA	KICK PLATE	8400 8" X 1" LDW B-CS	695	IVE
2	EA	SILENCER	SR64/SR65 AS REQUIRED	GRY	IVE

NOTE:
EXISTING DOOR AND FRAME TO REMAIN
VERIFY EXISTING DOOR AND FRAME PREPS FOR COMPATIBILITY OF SPECIFIED HARDWARE
VERIFY EXISTING HINGES, LOCK STRIKE PREP AND FURNISH REQUIRED STRIKE TO FIT.
GC TO PATCH EXISTING HOLES AND PROVIDE BLOCKING FOR EXISTING LOCK PREP
REMOVE KICK DOWN DOOR STOPS

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Door Numbers	HwSet#
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002	06A
003	06B
004	04A
005.1	06E
006	04A
006.1	01A
007	04A
007.1	03A
008	04A
008.1	01A
010	06D
011	04A
012	06D
013	06D
014	
015	09A
017	04A
017.1	01A
018	04A
019	04A
020	04A
020.1	01A
021	06C
022	
023	04E
025	06F
026.1	06F
026.2	01A
027.1	05D
027.2	05D
028	09A
030	06B
032	06J
033	06B
034	06D
100.1	01B
100.2	01H
101	02G
102.1	08A
102.2	
104	04G
104.1	10B

Door Numbers	HwSet#
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106.1	10B
108.1	11A
108.2	11A
108.3	01E
109	04A
110	04A
111	03A
112	04A
113	04A
114.1	04E
114.2	08B
115	04F
115.1	04B
115.2	04E
115.3	06K
115.4	04E
115.5	04E
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116.2	04A
116.3	04A
116.4	04A
116.5	04A
116.6	10A
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116.8	10A
116.9	10A
201	08A
202	04F
202.1	
202.2	04A
202.3	04A
202.4	04A
202.5	04A
202.6	04A
203	04C
203.1	03B
204.1	03A
205	04C
205.1	05B
205.2	04A

205.3	04A
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206	03A
207	
207.1	06A
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209-2	04F
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209.3	04A
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211-1	04C
211-2	04C
211.1	04E
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211.5	04E
211.6	10A
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ST-1.2	01G
ST-1.3	01F
ST-1.4	02A
ST-1.5	02C
ST-2.1	02E
ST-2.2	01D
ST-2.3	02A
ST-2.4	02D
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T100	07A
T101	07A
T-200	07C
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END OF SECTION 08 71 00

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Glass products.
2. Insulating glass.
3. Glazing sealants.
4. Glazing tapes.
5. Miscellaneous glazing materials.

B. Related Requirements:

1. Section 08 11 13 “Hollow Metal Doors and Frames.”
2. Section 08 14 16 “Flush Wood Doors.”
3. Section 08 41 13 "Aluminum-Framed Entrances and Storefronts."
4. Section 08 44 13 "Glazed Aluminum Curtain Walls."
5. Section 08 88 13 "Fire-Rated Glazing."

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

C. IBC: International Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.

1. Tinted glass.

2. Coated glass.
3. Laminated glass.
4. Insulating glass.

C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch (300-mm) lengths. Install sealant Samples between two strips of material representative in color of adjoining framing system.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer manufacturers of fabricated glass units glass testing agency and sealant testing agency.

B. Product Certificates: For glass.

C. Product Test Reports: For fabricated glass and glazing sealants, for tests performed by a qualified testing agency.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Preconstruction adhesion and compatibility test report.

E. Sample Warranties: For special warranties.

1.8 QUALITY ASSURANCE

A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved and certified by primary glass manufacturer.

B. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

E. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Install glazing in mockups specified in Section 08 41 13 "Aluminum-Framed Entrances and Storefronts" Section 08 51 13 "Aluminum Windows" to match glazing systems required for Project, including glazing methods.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.12 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: Five years from date of Substantial Completion.

C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

D. Manufacturer's Special Warranty for Heat-Soaked Tempered Glass: Manufacturer agrees to replace heat-soaked tempered glass units that spontaneously break due to nickel sulfide (NiS) inclusions at a rate exceeding 0.3 percent (3/1000) within specified warranty period. Coverage for any other cause is excluded.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Glass: Obtain glass from single source from single manufacturer.

B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design glazing.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:

1. Design Wind Pressures: As indicated on Drawings .

a. Wind Design Data: As indicated on Drawings.

2. Design Snow Loads: As indicated on Drawings.
3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6 mm thick .
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on LBL's WINDOW 7 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
5. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on LBL's WINDOW 7 computer program.
6. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."

2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction [or] [manufacturer]. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.

1. Minimum Glass Thickness for Exterior Lites: 6 mm .
2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

B. Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AGC Glass Company North America, Inc.
b. Guardian Glass LLC.
c. Pilkington North America; NSG Group.
d. Saint-Gobain Glass Corp.
e. Vitro Architectural Glass.

C. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

D. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

E. Pyrolytic-Coated, Low-Maintenance Glass: Clear float glass with coating on first surface having both photocatalytic and hydrophilic properties that act to loosen dirt and to cause water to sheet evenly over the glass instead of beading.

F. Reflective- and Low-E-Coated Vision Glass: ASTM C1376.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Guardian Glass LLC.
b. Pilkington North America; NSG Group.
c. Saint-Gobain Glass Corp.
d. Vitro Architectural Glass.

G. Ceramic-Coated Vision Glass: ASTM C1048, Condition C, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3; and complying with Specification No. 95-1-31 in NGA's "Engineering Standards Manual."

2.5 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Perimeter Spacer: Manufacturer's standard spacer material and construction .
3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As indicated by manufacturer's designations .

B. Neutral-Curing Silicone Glazing Sealant, Class 50: Complying with ASTM C920, Type S, Grade NS, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. GE Construction Sealants; Momentive Performance Materials Inc.
b. Pecora Corporation.
c. Polymeric Systems, Inc.
d. Sika Corporation.
e. The Dow Chemical Company.
f. Tremco Incorporated.

2.7 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks:

1. EPDM Silicone Neoprene with Shore A durometer hardness of 85, plus or minus 5.
2. Type recommended in writing by sealant or glass manufacturer.

D. Spacers:

1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
2. Type recommended in writing by sealant or glass manufacturer.

E. Edge Blocks:

1. EPDM Silicone Neoprene with Shore A durometer hardness per manufacturer's written instructions.
2. Type recommended in writing by sealant or glass manufacturer.

F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.9 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

a. Temperature Change: 120 deg F (67 deg C) , ambient; 180 deg F (100 deg C) , material surfaces .

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch- (3-mm-) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.6 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.7 MONOLITHIC GLASS SCHEDULE

A. Clear Glass Type : Fully tempered float glass.

1. Minimum Thickness: 6 mm .
2. Safety glazing required.

3.8 INSULATING GLASS SCHEDULE

A. Low-E-Coated, Clear Insulating Glass Type :

1. Overall Unit Thickness: 1 inch (25 mm) .
2. Minimum Thickness of Each Glass Lite: 6 mm .
3. Outdoor Lite: Fully tempered float glass.
4. Interspace Content: Air .
5. Indoor Lite: Fully tempered float glass.
6. Low-E Coating: Sputtered on second surface.
7. Winter Nighttime U-Factor: 0.28 maximum.
8. Summer Daytime U-Factor: 0.26 maximum.
9. Visible Light Transmittance: 64 percent minimum.
10. SGHC: 0.27 maximum.
11. Safety glazing required.

B. Low-E-Coated, Tinted Insulating Glass Type :

1. Overall Unit Thickness: 1 inch (25 mm) .
2. Minimum Thickness of Each Glass Lite: 6 mm .
3. Outdoor Lite: Tinted fully tempered float glass.
4. Tint Color: Gray .
5. Interspace Content: Air .
6. Indoor Lite: Clear fully tempered float glass.
7. Low-E Coating: Sputtered on second surface.
8. Winter Nighttime U-Factor: 0.28 maximum.
9. Summer Daytime U-Factor: 0.26 maximum.
10. Visible Light Transmittance: 26 percent minimum.
11. SGHC: 0.17 maximum.
12. Safety glazing required.

3.9 INSULATING-LAMINATED-GLASS SCHEDULE

A. Low-E-Coated, Clear Insulating Laminated Glass Type :

1. Basis-of-Design Product: <Insert manufacturer's name; product name or designation>.
2. Overall Unit Thickness: 1-3/16 inch (30 mm) .
3. Minimum Thickness of Outdoor Lite: 6 mm .
4. Outdoor Lite: Clear fully tempered float glass.
5. Interspace Content: Air .
6. Indoor Lite: Clear laminated glass with two plies of fully tempered float glass.

    a. Minimum Thickness of Each Glass Ply: 6 mm .
    b. Interlayer Thickness: 0.060 inch (1.52 mm) .

7. Low-E Coating: Sputtered on second surface.
8. Winter Nighttime U-Factor: 0.28 maximum.
9. Summer Daytime U-Factor: 0.26 maximum.
10. Visible Light Transmittance: 64 percent minimum.
11. SGHC: 0.27 maximum.
12. Safety glazing required.

B. Low-E-Coated, Tinted, Insulating Laminated Glass Type :

1. Overall Unit Thickness: 1-3/16 inch (30 mm) .
2. Minimum Thickness of Outdoor Lite: 6 mm .
3. Outdoor Lite: Tinted fully tempered float glass.
4. Tint Color: Gray .
5. Interspace Content: Air .
6. Indoor Lite: Clear laminated glass with two plies of fully tempered float glass.

    a. Minimum Thickness of Each Glass Ply: 6 mm .
    b. Interlayer Thickness: 0.060 inch (1.52 mm) 0.090 inch (2.29 mm).

7. Low-E Coating: Sputtered on second surface.
8. Winter Nighttime U-Factor: 0.28 maximum.
9. Summer Daytime U-Factor: 0.26 maximum.
10. Visible Light Transmittance: 64 percent minimum.
11. SGHC: 0.27 maximum.
12. Safety glazing required.

END OF SECTION 08 80 00

SECTION 08 87 00 - ARCHITECTURAL WINDOW FILMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes

1. Interior/Exterior Window Film

B. Related Requirements

1. Section 08 41 13 "Aluminum-Framed Entrances and Storefronts"
2. Section 08 44 13 “Glazed Aluminum Curtain Walls”
3. Section 08 80 00 "Glazing"

1.3 REFERENCES

A. ASTM International (ASTM)

1. ASTM E 903 - Standard Methods of Test for Solar Absorbance, Reflectance and Transmittance of Materials Using Integrating Spheres
2. ASTM E 308 - Standard Recommended Practice for Spectrophotometry and Description of Color in CIE 1931 System

1.4 SUBMITTALS

A. Manufacturer's Product Data for specified products.

B. Submit shop drawings showing layout, profiles, and product components, including dimensions, anchorage, and accessories.

C. Samples: 4 inch by 4 inch Samples of specified texture, color and/or pattern for verification.

D. Submit operation and maintenance data for installed products, including precautions against harmful cleaning materials and methods.

E. Mock ups: as required.

1.5 QUALITY ASSURANCE

A. Obtain all products in this section from a single Manufacturer with a minimum of 10 years’ experience.

B. Installer: Installation shall be performed by a trained and qualified installer, specialized and experienced in work required for this project.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Store products protected from weather, temperature, and other harmful conditions as recommended by supplier.

C. Product must remain in original plastic bag and boxes and have storage conditions as follows:

1. 40 °F – 90 °F (4 °C – 32 °C)
2. Out of direct sunlight
3. Clean dry area
4. Original container
5. Do not stack boxes over six (6) units high. Excessive weight can damage the film
6. Products are not recommended for interior applications where condensation consistently occurs.
7. Handle products in accordance with manufacturer's instructions.
8. Shelf life: 1 year

1.7 PROJECT/SITE CONDITIONS

A. Confirm appropriate substrate is suitable for mounting of glass finish components prior to start of installation.

B. Apply materials when environmental conditions are within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits. Application temperature range is 60 °F – 100 °F (16 °C – 38 °C).

C. Environmental Limitations: Do not install until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.8 WARRANTY

A. Manufacturer's Warranty: Submit manufacturer's standard warranty document by authorized manufacturer.

1.9 EXTRA MATERIALS

A. Furnish 2 percent extra material at time of installation. Deliver in protective packaging for storage and label contents appropriately.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. 3M Company – Commercial Solutions Division [CSD], or approved equal.

2.2 FROSTED CRYSTAL FILM

A. Products: Subject to compliance with requirements, provide the following:

1. 3M Crystal Glass Finishes 772SE-324.
2. Film Color: Frosted.
3. Adhesive: Acrylic, Pressure Sensitive, Permanent
4. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.
5. Thickness (Average): 4.7 mils (90 microns)
6. VLT: 72%

2.3 SAFETY AND SECURITY FILM

A. Products: Subject to compliance with requirements, provide the following:

1. 3M Safety S80 Optically clear polyester film with a durable acrylic abrasion resistant coating over one surface and a pressure sensitive adhesive over the other.
2. Film Color: Clear
3. Break Strength: 200lbs/inch ASTM D 882
4. Adhesive: Acrylic, Pressure Sensitive, Permanent
5. Uniformity: No noticeable pin holes, streaks, thin spots, scratches, banding or other optical defects.

6. Thickness (Average) (Film and Adhesive without Liner): 3.2 mils (80 microns)
7. Fire Performance: Surface burning characteristics when tested in accordance with ASTM E84: Class A

    a. Flame Spread: 25 maximum.

8. Smoke Developed: 450 maximum.
9. Impact: Level III Security

PART 3 - EXECUTION

3.1 GENERAL

A. Multi-layered: where the drawings call for both frosted and security, the security film shall be installed prior to the frosted unless otherwise recommended by the manufacturer.

B. Factory installation: where new glazing units (windows, storefront, entrances, or curtainwalls) are required to have film, the film shall be factory installed edge-to-edge on the glazing and not field-applied.

3.2 EXAMINATION

A. Examine substrate(s) for compliance. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Refer to the applicable 3M Technical Data Sheet to determine compatibility of finish to substrate.

C. Do not proceed with installation until unsatisfactory conditions have been corrected.

D. Responsibility for state of surfaces prior to installation to be pre-determined by installation specialist.

E. Scheduling of installation by Owner or its representative implies that substrate and conditions are prepared and ready for product installation per the recommendations of the installation specialist.

F. Proceeding with installation implies installer's acceptance of substrate and conditions.

3.3 SURFACE PREPARATION

A. Comply with all manufacturer's instructions for surface preparation.

B. Thoroughly clean substrate of substances that could impair the overlay's bond, including mold, mildew, oil, grease.

C. Re-clean surfaces with appropriate surface prep solvent and remove any haze or surface contamination.

3.4 APPLICATION

A. Refer to the applicable 3M Installation Guide for specific application instructions.

B. Application must be performed by qualified installer.

C. Do not proceed with installation until all finishing work has been completed in and around the work area.

D. Verify pattern prior to material acquisition.

E. Comply with manufacturer's installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

F. Remove the liner and wet the adhesive prior to installation.

G. Form smooth, wrinkle-free, bubble-free surface for finished installation.

H. Remove air bubbles, wrinkles, blisters and other defects. Use approved procedures to prevent the formation of air bubbles, wrinkles, blisters and other defects.

I. Residual water phenomenon may cause small water bubbles or clouding in the film that disappears as the water evaporates.

J. Refer to the applicable 3M Installation Guide for additional details.

3.5 CLEANING AND PROTECTION

A. Use cleaning methods recommended by architectural surfacing manufacturer for applicable environment.

B. Protect completed glass finish during remainder of construction period.

C. Consult with authorized installation specialist for project specifics.

END OF SECTION 08 87 00

SECTION 08 88 13 - FIRE-RATED GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fire-protection-rated glazing.
2. Fire-resistance-rated glazing.

1.3 DEFINITIONS

A. Fire-Protection-Rated Glazing: Glazing that prevents spread of fire and smoke and complies with requirements for rated openings; incapable of blocking radiant heat

B. Fire-Resistance-Rated Glazing: Glazing that prevents spread of fire and smoke and radiant heat and complies with requirements for rated walls and rated openings; capable of blocking radiant heat

C. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

D. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

1.4 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of glass product; 12 inches (300 mm) square.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer .

B. Product Certificates: For each type of glass and glazing product.

C. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the NGA's Certified Glass Installer Program.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install fire-resistant glazing until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature conditions at occupancy levels during remainder of construction period.

1.10 WARRANTY

A. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: Five years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Tempered Glazing Units with Clear Intumescent Interlayer: Manufacturer agrees to replace units that deteriorate within specified warranty period. Deterioration of tempered glazing units with clear intumenscent interlayer is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning glass contrary to manufacturer's written instructions. Evidence of failure is air bubbles within units, or obstruction of vision by contamination or deterioration of intumescent interlayer.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Glass: For each glass type, obtain from single source from single manufacturer.

B. Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organization below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. NGA Publications: "Glazing Manual."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction . Label shall indicate manufacturer's name, type of glass, glass thickness, and safety glazing standard with which glass complies.

2.4 GLASS PRODUCTS

A. Float Glass: ASTM C1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Low-Iron Float Glass: ASTM C1036, Type I, Quality-Q3, Class I (clear), with visible light transmission not less than 91 percent.

C. Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class I (clear) unless otherwise indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

D. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer unless fire-protection or fire-resistance rating is based on another product.
2. Interlayer Thickness: Provide thickness as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

2.5 FIRE-PROTECTION-RATED GLAZING

A. General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on positive-pressure testing in accordance with NFPA 257 or UL 9, including hose-stream test, and shall comply with NFPA 80.

1. Fire-protection-rated glazing required to have a fire-protection rating of 20 minutes shall be exempt from hose-stream test.

B. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether glazing has passed hose-stream test; whether glazing meets 450 deg F (250 deg C) temperature-rise limitation; and fire-resistance rating in minutes.

C. Fire-Protection-Rated Tempered Glass: 6-mm thickness; fire-protection-rated tempered glass; complying with 16 CFR 1201, Category II.

1. Manufacturers: Subject to compliance with requirements, provide one of the following:

a. McGrory Glass, Inc.
b. SAFTI FIRST Fire Rated Glazing Solutions.
c. Technical Glass Products; an Allegion brand.
d. Vetrotech Saint-Gobain.

D. Fire-Protection-Rated Monolithic Glass for Doors and Protected Openings: 19-mm thickness; low-iron fire-protection-rated glass; complying with 16 CFR 1201, Category II. UL listed and tested in accordance with NFPA 252 for fire-rated doors and NFPA 257 for protected openings with hose-stream testing.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. McGrory Glass, Inc.
b. SAFTI FIRST Fire Rated Glazing Solutions.

E. Fire-Protection-Rated Monolithic Glass for Doors Only: 19-mm thickness; clear, fire-protection glass; complying with 16 CFR 1201, Category II. UL listed and tested in accordance with NFPA 252 for fire-rated doors with hose-stream testing.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. McGrory Glass, Inc.
    b. SAFTI FIRST Fire Rated Glazing Solutions.

2.6 FIRE-RESISTANCE-RATED GLAZING

A. General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-resistance ratings indicated, based on testing in accordance with ASTM E119 or UL 263.

B. Fire-Resistance-Rated Glazing Labeling: Permanently mark fire-resistance-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, that glazing is approved for use in walls, and fire-resistance rating in minutes.

C. Fire-Resistance-Rated Tempered Glazing Units with Clear Intumescent Interlayer: Glazing units made from two or more lites of uncoated, fully tempered, float glass; with a perimeter edge seal enclosing a cavity filled with optically clear, intumescent polymer; complying with 16 CFR 1201, Category II.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. SAFTI FIRST Fire Rated Glazing Solutions.

2.7 GLAZING ACCESSORIES

A. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with glazing products and each other and are approved by testing agencies that listed and labeled fire-resistant glazing products with which products are used for applications and fire-protection ratings indicated.

B. Glazing Sealants for Fire-Rated Glazing Products: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. GE Construction Sealants; Momentive Performance Materials Inc.
    b. The Dow Chemical Company.
    c. Tremco Incorporated.

2. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.

C. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

D. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

C. Perimeter Insulation for Fire-Resistance-Rated Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.9 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with manufacturing and installation tolerances, including those for size, squareness, and offsets at corners, and for compliance with minimum required face and edge clearances.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate fire side and protected side. Label or mark units as needed so that fire side and protected side are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Use methods approved by testing agencies that listed and labeled fire-resistant glazing products.

B. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch- (3-mm-) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

I. Set glass lites with proper orientation so that coatings face fire side or protected side as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop, so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

D. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 08 88 13

SECTION 08 91 19 - FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fixed, extruded-aluminum louvers.

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).

C. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on a uniform pressure of 30 lbf/sq. ft. (1436 Pa), acting inward or outward.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Wind-Driven-Rain-Resistant Louver:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model A4097 4” High Performance Drainable Fixed Mullion Louver as manufactured by Construction Specialties, Inc. or comparable product by one of the following:

a. Airolite Company, LLC (The).
b. Ruskin Company; Tomkins PLC.
c. United Enertech.
d. Greenheck

2. Louver Depth: 4”.
3. Frame Nominal Thickness: Not less than 0.081 inch.
4. Blades: Horizontal rain resistant style, heavy gauge extruded 6063-T5 aluminum, 0.081 in. nominal wall thickness, positioned on approximately 2 in. blade spacing.
5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Insect screen.

B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Rewirable frames with a driven spline or insert.

2.5 BLANK-OFF PANELS

A. Insulated, Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.

1. Thickness: 2 inches (50 mm).
2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch (0.81-mm) nominal thickness.
3. Insulating Core: extruded-polystyrene foam.
4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch (2.03-mm) nominal thickness, with corners mitered and with same finish as panels.
5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
6. Panel Finish: Same type of finish applied to louvers, but black color.
7. Attach blank-off panels with sheet metal screws.

2.6 MATERIALS

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use tamper-resistant screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
3. For color-finished louvers, use fasteners with heads that match color of louvers.

D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.7 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern unless horizontal mullions are indicated where indicated.
2. Horizontal Mullions: Provide horizontal mullions at joints unless continuous vertical assemblies are indicated.

C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Exterior flange unless otherwise indicated.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches (1830 mm) o.c., whichever is less.

1. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.

G. Provide subsills made of same material as louvers or extended sills for recessed louvers.

H. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.8 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: Match Architect's sample.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 08 91 19

SECTION 09 01 60.91 – FLOOR RESTORATION - TERRAZZO

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Refinishing terrazzo floors.
2. Provide all labor, material, and equipment necessary to complete the following terrazzo repair work.
3. Preparation of all surfaces to receive patching compound.
4. Repairs to delaminated areas.
5. Repair of cracks (as per NTMA recommendations).
6. Placement of patching compounds/terrazzo matrix.
7. Finish and curing of terrazzo.

1.3 REFERENCE STANDARDS

A. NTMA - Terrazzo Specifications; The National Terrazzo and Mosaic Association, Inc.; current edition located at www.ntma.com.

1.4 SUBMITTALS

A. Product Data: Provide manufacturers technical data for sealer and cleaner and grout.

B. Cleaning products to be used and Terrazzo Maintenance Data/Protocols for facility managers.

C. Submit letter clearly identifying the terrazzo system (Epoxy, Cement, etc) and that the products are suitable/compatible.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with not fewer than 5 years of documented experience.

1. Installer shall be a contractor member of NTMA in good standing and shall perform all work in accordance with NTMA standards
2. Use only skilled journeyman who are familiar and experienced with the materials and methods specified shall be used for terrazzo restoration/refinishing.
3. Crack Repair: Prepare a sample area for each type of crack repair required (Hairline cracks 1/64” to 1/16" in size; Cracks and voids larger than 1/8”) Repair shall demonstrate methods and quality of workmanship of crack repair.
4. Patching: Prepare on-floor, a sample of patching. Patch shall demonstrate methods and quality of workmanship of patch repair.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaner: Potable water, free of iron, all cleaners (optional) must be pH neutral.

B. Sealer: Liquid type to completely seal matrix surface; not detrimental to terrazzo components.

C. Grout: Color to match existing matrix.

D. Matrix: Pigmented epoxy to match existing.

E. Aggregates: Aggregates to match existing.

2.2 EQUIPMENT

A. All work shall be executed with conventional terrazzo grinding equipment according to NTMA published trade practice.

2.3 EXISTING TERRAZZO BASE

A. Once existing paint has been removed from top edge, per architectural drawings, polish top edge as required, to restore a finished appearance.

PART 3 - EXECUTION

3.1 GENERAL

A. Perform work in accordance with NTMA recommendations as posted on the NTMA website (www.ntma.com).

3.2 PREPARATION

A. Cover and protect all adjacent finished surfaces during restoration process.

3.3 CRACK REPAIR

A. Determination

1. The owner and contractor shall walk the entire floor and identify cracks and agree on:

a. NA (No Action) RC (Repair Crack) or RT (Replace Terrazzo).
b. Hairline cracks are classified as less than 1/32” (0.030).
c. Replacement (RT) shall be from architectural break to architectural break.

B. RC – Repair Crack

1. Clean crack of loose material, dirt or sealer.
2. Fill with resin/to match existing. Use aggregate in the crack if crack is wider than ¼ inch.

C. RT – Relace Terrazzo (if repair is not to architectural break or existing terrazzo divider strip, the joining edge shall be a saw tooth (jagged edge)

1. Remove areas to be replaced.
2. Clean area and prepare concrete for new terrazzo.
3. Repair concrete, fill cracks in concrete substrate as needed. Fill cracks in concrete with hardening epoxy.

a. Optional upgrade: Employ the use of a mesh (isolation membrane) to cover crack with liquid applied membrane (epoxy systems only).

4. Fill area with epoxy or cement /cement matrix and approved aggregate mixture/blend.

3.4 INITIAL GRINDING

A. Wet or dry grind with appropriate medium diamonds/Stones.

3.5 GROUTING

A. Cleanse floor with clean water and rinse. Wet grind with 50 or higher abrasive grit medium diamonds.

B. Remove excess water and machine or hand grout with cement or epoxy material to fill as needed.

3.6 CURING GROUT

A. Allow grout to cure a minimum of 12 hours. Maintain ambient air temperature between 70°F (21°C) and 80°F (27°C).

3.7 FINE (FINAL) GRINDING

A. Grind with 120 grit carborundum or 200 grit resin bond diamond until grout has been removed from the terrazzo surface.

3.8 CLEANING AND SEALING

A. Rinse with clean water and allow too thoroughly dry.

B. Seal: Apply sealer per sealer manufacturer's written directions.

C. Remove protection and clean any adjacent surfaces effected by the refinishing process.

3.9 PROTECTION

A. General Contractor shall protect the finish floor from all site activity until Substantial Completion.

END OF SECTION 09 01 60.91

SECTION 09 01 90.52 - MAINTENANCE REPAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section

1.2 SUMMARY

A. Section includes preparation, repair, and maintenance repainting of existing interior and exterior painted substrates designated to remain, including removal of deteriorated coatings, patching of existing substrates, spot priming, transition coats, and application of finish coatings

1. Removing existing paint.
2. Patching substrates.
3. Repainting, including staining and varnishing of wood.

B. Related Sections include the following:

1. Section 09 91 23 “Interior Painting” for additional painting requirements for new work.
2. Section 09 91 13 “Exterior Painting” for additional painting requirements for new work.

1.3 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of paint system and each pattern, color, and gloss.

1. For each painted color being matched to a standardized color-coding system, include the color chips from the color-coding-system company with Samples.
2. Label each Sample for location and application.

1.6 QUALITY ASSURANCE

A. Mockups: Prepare mockups of maintenance repainting processes for each type of coating system and substrate indicated and each color and finish required to demonstrate aesthetic effects and to set quality standards for materials and execution. Duplicate appearance of approved Sample submittals.

1. Surface-preparation mockups using applicable specified methods of cleaning and other surface preparation.
2. Coating mockups to represent surfaces and conditions for application of each type of coating system.

PART 2 - PRODUCTS

2.1 PREPARATORY CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F.

C. Detergent Solution: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 1/2 cup of laundry detergent that contains no ammonia, 5 quarts of 5 percent sodium hypochlorite bleach, and 15 quarts of warm water for every 5 gal. of solution required.

D. Mildewcide: Commercial proprietary mildewcide or a job-mixed solution prepared by mixing 1/3 cup of household detergent that contains no ammonia, 1 quart of 5 percent sodium hypochlorite bleach, and 3 quarts of warm water.

E. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors: As selected by Architect from full range of industry colors.

2.3 PAINT MATERIALS, GENERAL

A. Transition Coat: Paint manufacturer's recommended coating for use where a residual existing coating is incompatible with the paint system.

2.4 PAINT MATERIAL MANUFACTURERS

A. Basis of Design: Sherwin Williams or equal.

2.5 PAINT MATERIALS

A. Primers and Sealers:

1. Primer, Latex, for Interior Wood:

a. Basis-of-Design Product: SW PreRite ProBlock Primer Sealer.

2. Primer, Rust-Inhibitive, Waterborne, for ferrous metal:

a. Basis-of-Design Product: S-W Pro Industrial Pro-Cryl Universal Acrylic Primer.
b. Suitable for interior and exterior use and compatible with specified finish coatings

3. Primer / Sealer, Acrylic, for Exterior Masonry:

a. Basis-of-Design: SW Loxon Concrete & Masonry Primer/Sealer.

4. Stain, Semi-Transparent, for Interior Wood:

a. Basis-of-Design Product: SW Minwax Performance Series Tintable Wood Stain

B. Wood Primers:

1. Primer, Exterior Wood:

a. Basis-of-Design Product: S-W Exterior Latex Primer.

C. Water-Based Paints:

1. Latex, Interior, Flat, (Gloss Level 1):

a. Basis-of-Design Product: SW ProMar 200 Zero VOC Latex Flat.

2. Latex, Interior, (Gloss Level 3):

a. Basis-of-Design Product: SW ProMar 200 Zero VOC Latex Eg-Shel.

3. Latex, Interior, Semigloss, (Gloss Level 5):

a. Basis-of-Design Product: SW ProMar 200 Zero Latex Semi-Gloss.

4. Latex, Exterior, 100 Percent Acrylic, Flat or Low Lustre:

a. Basis-of-Design: SW Duration Exterior Acrylic Latex.

5. Latex, Exterior, 100 Percent Acrylic, Gloss (Gloss Level 6):

a. Basis-of-Design: SW Duration Exterior Acrylic Latex Gloss.

D. Waterborne Enamels:

1. Waterborne Urethane-Modified Alkyd Enamel, Interior, Semigloss (Gloss Level 5): MPI #169:

a. Basis-of-Design: SW Emerald Urethane Trim Enamel Semi-Gloss.

E. Polyurethane Varnishes:

1. Varnish, Interior, Polyurethane, Water-based clear finish, Gloss (Gloss Level 6):

a. Basis-of-Design Product: SW Minwax Polycrylic Protective Finish

2.6 PATCHING MATERIALS

A. Wood-Patching Compound: Two-part, epoxy-resin, wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be designed for filling voids in damaged wood materials that have deteriorated from weathering and decay. Compound shall be capable of filling deep holes and spreading to feather edge.

B. Gypsum-Plaster Patching Compound: Finish coat plaster and bonding compound according to ASTM C 842 and manufacturer's written instructions.

PART 3 - EXECUTION

3.1 MAINTENANCE REPAINTING, GENERAL

A. Execution of the Work: In repainting surfaces, disturb them as minimally as possible and as follows:

1. Remove failed coatings and corrosion and repaint.
2. Verify that substrate surface conditions are suitable for repainting.
3. Allow other trades to repair items in place before repainting.

B. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use gentle methods, such as scraping and lightly hand sanding, that will not abrade softer substrates, reducing clarity of detail.

C. Heat Processes: Do not use torches, heat guns, or heat plates.

3.2 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of painting work. Comply with paint manufacturer's written instructions for inspection.

B. Maximum Moisture Content of Substrates: Do not begin application of coatings unless moisture content of exposed surface is below the maximum value recommended in writing by paint manufacturer and not greater than the following maximum values when measured with an electronic moisture meter appropriate to the substrate material:

1. Gypsum Board: 12 percent.
2. Wood: 15 percent.

C. Alkalinity: Do not begin application of coatings unless surface alkalinity is within range recommended in writing by paint manufacturer. Conduct alkali testing with litmus paper on exposed plaster, cementitious, and masonry surfaces.

3.3 PREPARATORY CLEANING

A. General: Use the gentlest, appropriate method necessary to clean surfaces in preparation for painting. Clean all surfaces, corners, contours, and interstices.

B. Detergent Cleaning: Wash surfaces by hand using clean rags, sponges, and bristle brushes. Scrub surface with detergent solution and bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet. Rinse with water applied by clean rags or sponges.

C. Solvent Cleaning: Use solvent cleaning to remove oil, grease, smoke, tar, and asphalt from painted or unpainted surfaces before other preparation work. Wipe surfaces with solvent using clean rags and sponges. If necessary, spot-solvent cleaning may be employed just prior to commencement of paint application, provided enough time is allowed for complete evaporation. Use clean solvent and clean rags for the final wash to ensure that all foreign materials have been removed. Do not use solvents, including primer thinner and turpentine, that leave residue.

D. Mildew: Clean off existing mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. Rinse with water applied by clean rags or sponges.

3.4 PAINT REMOVAL

A. General: Remove paint where indicated. Where cleaning methods have been attempted and further removal of the paint is required because of incompatible or unsatisfactory surfaces for repainting, remove paint to extent required by conditions.

1. Brushes: Use brushes that are resistant to chemicals being used.

a. Wood Substrates: Do not use wire brushes.

2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.

a. Equip units with pressure gages.
b. Unless otherwise indicated, hold spray nozzle at least 6 inches from surface and apply material in horizontal, back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.
c. For chemical spray application, use low-pressure tank or chemical pump suitable for chemical indicated, equipped with nozzle having a cone-shaped spray.
d. For water-spray application, use fan-shaped spray tip that disperses water at an angle of 25 to 50 degrees.
e. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F at flow rates indicated.

B. Paint Removal with Hand Tools: Remove paint manually using hand-held scrapers, wire brushes, sandpaper, and metallic wool as appropriate for the substrate material.

3.5 SUBSTRATE REPAIR

A. General: Repair substrate surface defects that are inconsistent with the surface appearance of adjacent materials and finishes.

B. Wood Substrate:

1. Repair wood defects including dents and gouges more than 1/4 inch in size and all holes and cracks by filling with wood-patching compound and sanding smooth. Reset or remove protruding fasteners.
2. Where existing paint is allowed to remain, sand irregular buildup of paint, runs, and sags to achieve a uniformly smooth surface.

C. Gypsum-Plaster and Gypsum-Board Substrates:

1. Repair defects including dents and chips more than 1/4 inch in size and all holes and cracks by filling with gypsum-plaster patching compound and sanding smooth. Remove protruding fasteners.
2. Rout out surface cracks to remove loose, unsound material; fill with patching compound and sand smooth.

3.6 PAINT APPLICATION, GENERAL

A. Prepare surfaces to be painted according to the Surface-Preparation Schedule and with manufacturer's written instructions for each substrate condition.

B. Apply a transition coat over incompatible existing coatings.

C. Blending Painted Surfaces: When painting new substrates patched into existing surfaces or touching up missing or damaged finishes, apply coating system specified for the specific substrate. Apply final finish coat over entire surface from edge to edge and corner to corner.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage paint-remover manufacturer's factory-authorized service representative for consultation and Project-site inspection and to provide on-site assistance when requested by Architect.

3.8 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.9 SURFACE-PREPARATION SCHEDULE

A. General: Before painting, prepare surfaces where indicated on Drawings for painting according to applicable requirements specified in this schedule.

1. Examine surfaces to evaluate each surface condition according to paragraphs below.
2. Where existing degree of soiling prevents examination, preclean surface and allow it to dry before making an evaluation.
3. Repair substrate defects according to "Substrate Repair" Article.

B. Surface Preparation for MPI DSD 2 Degree of Surface Degradation:

1. Surface Condition: Paint film loose, flaking, or peeling.
2. Paint Removal: Remove loose, flaking, or peeling paint film by hand-tool or chemical paint-removal methods.
3. Preparation for Painting: Wash surface by detergent cleaning; use solvent cleaning where needed. Use other cleaning methods for small areas of bare substrate if required. Sand surfaces to smooth remaining paint film edges. Prepare bare cleaned surface to be painted according to paint manufacturer's written instructions for substrate construction materials.

3.10 EXTERIOR MAINTENANCE REPAINTING SCHEDULE

A. Metal railings:

1. Alkyd System: MPI REX 6.2C system over a transition coat.

a. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Alkyd for Exterior Wood.
b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Alkyd, exterior gloss (Gloss Level 6).
d. Color: As selected by Architect from manufacturer’s full range.

B. Stucco Wall Panels:

1. Acrylic Latex System over sound existing coating.

a. Prepare surfaces by removing loose, peeling, chalking, and otherwise unsound coatings; clean biological growth and contaminants.
b. Prime Coat: Spot prime exposed/uncoated stucco and repaired areas with acrylic masonry primer/conditioner recommended by coating manufacturer.
c. Intermediate Coat: Exterior 100 percent acrylic latex matching topcoat.
d. Topcoat: Exterior 100 percent acrylic latex, flat or low-sheen.

e. Color: As selected by Architect from manufacturer's full range.

C. Wood Doors Windows Frames Casings and Smooth Fasciae:

1. Exterior Acrylic System: MPI REX 6.3B system over a transition coat.

a. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Latex for Exterior Wood.
b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior gloss (Gloss Level 6).
d. Color: As selected by Architect from manufacturer's full range.

3.11 INTERIOR MAINTENANCE REPAINTING SCHEDULE

A. Wood Doors Windows Frames and Moldings:

1. Low-Odor Latex System over Latex Primer: MPI RIN 6.3V system over a transition coat.

a. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with Primer, Latex, for Interior Wood.
b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, semigloss (Gloss Level 5).
d. Color: As selected by Architect from manufacturer's full range.

B. Wood Floors and Stairs:

1. Alkyd Floor Enamel System: MPI RIN 6.5A system over a transition coat.

a. Prime Coat: For MPI DSD 2 degree of surface degradation, spot prime with topcoat.
b. Intermediate Coat: Floor enamel matching topcoat.
c. Topcoat: Floor paint, alkyd, low gloss.
d. Color: As selected by Architect from manufacturer's full range.

C. Ferrous Metal Railings and Steel Windows:

1. Acrylic/Waterborne Enamel System over compatible existing coating and transition coat where required.

a. Prime Coat: At areas of exposed steel and corrosion, spot prime with rust-inhibitive metal primer, MPI #107 or coating manufacturer's recommended primer.
b. Intermediate Coat: Waterborne urethane-modified alkyd enamel matching topcoat.
c. Topcoat: Waterborne urethane-modified alkyd enamel, semigloss, Gloss Level 5.
d. Color: As selected by Architect from manufacturer's full range.

D. Plaster:

1. Low-Odor Latex System over Waterborne Primer: MPI RIN 9.2M system over a transition coat.

a. Prime Coat: For MPI DSD 3 degree of surface degradation, fully prime coat with Primer Sealer, Latex, Interior.
b. Topcoat: Latex, interior, institutional low odor/VOC flat (Gloss Level 1).
c. Color: As selected by Architect from manufacturer's full range.

END OF SECTION 09 01 90.52

SECTION 09 03 20 - HISTORIC TREATMENT OF PLASTER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Repair and replacement of historic interior lime plaster.
2. Replication of cast lime and gypsum plasterwork.

B. Related Requirements:

1. Section 01 35 91 "Historic Treatment Procedures" for general historic treatment requirements.
2. Section 06 10 53 "Miscellaneous Rough Carpentry" for wood framing, grounds, and furring that support lath and plaster.
3. Section 09 22 16 "Non-Structural Metal Framing" for non-load-bearing steel framing and furring that support lath and plaster.
4. Section 092613 "Gypsum Veneer Plastering" for gypsum-based veneer plaster applied on gypsum base for veneer plaster, unit masonry, and monolithic concrete.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review minutes of Preliminary Historic Treatment Conference that pertain to historic treatment of plaster.
2. Review methods and procedures related to historic treatment of plaster including, but not limited to, the following:

a. Verify historic treatment specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
b. Materials, material application, colors, patterns, and sequencing.
c. Fire-protection plan.
d. Plasterwork historic treatment program.

1.4 SEQUENCING AND SCHEDULING

A. Perform historic treatment of plaster in the following sequence, which includes work specified in this and other Sections:

1. Dismantle existing surface-mounted objects and hardware that overlie plaster surfaces except items indicated to remain in place. Tag items with location identification and protect.
2. Verify that temporary protections have been installed.
3. Examine condition of plaster surfaces.
4. Clean plaster surface and remove paint and other finishes to the extent required.
5. Repair and replace existing plaster and supports to the degree required for a uniform, tightly adhered surface on which to paint or apply other finishes.
6. Cure repaired surfaces and allow them to dry for proper finishing.
7. Paint and apply other finishes.
8. Reinstall dismantled surface-mounted objects and hardware unless otherwise indicated.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for product application and use.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified historic treatment specialist.

B. Plasterwork Historic Treatment Program: Submit before work begins.

1.7 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic plastering specialist with expertise in matching and performing the types of historic plasterwork repairs required. Experience only in installing and repairing new plasterwork, veneer plaster, or gypsum board is insufficient experience for historic treatment work.

B. Plasterwork Historic Treatment Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for historic treatment work and protection of surrounding materials and Project site.

1. Include methods and procedures to protect plastered surfaces from damage caused by construction operations, including, but not limited to, exposure to moisture, vibration, mechanical damage, and soiling.
2. If materials and methods other than those indicated are proposed for any phase of historic treatment work, add a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project.

C. Mockups: Prepare mockups of historic treatment processes for each type of plaster repair and reconstruction work to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Locate mockups in locations that enable viewing under same conditions as the completed Work.
2. Number and Size: Two wall surfaces of at least 50 sq. ft. (4.5 sq. m) or approximately 48 inches (1200 mm) in least dimension to represent surfaces and conditions for application of each type of plaster repair and reconstruction under same conditions as the completed Work. Include at least the following:

   a. Repair 3 linear ft. (1 m) of plaster cracks.
   b. Reattach 4-sq. ft. (4-sq. m) area of delaminated plaster that has not fallen.

3. Simulate finished lighting conditions for review of mockups.
4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

B. Store materials on elevated platforms, under cover, and in a dry location with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

C. Store hydrated lime and factory-prepared lime putty in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.

D. Store materials not in use in tightly covered containers.

E. Store lime putty covered with water in sealed containers.

F. Store sand where grading and other required characteristics can be maintained and contamination avoided.

1.9 FIELD CONDITIONS

A. Comply with plaster-material manufacturers' written instructions. For gypsum plaster, also comply with ASTM C 842 requirements.

B. Temperatures: Maintain temperatures in work areas at not less than 55 deg F (13 deg C) or greater than 80 deg F (27 deg C) for at least seven days before application of plaster, continuously during application, and for seven days after plaster has set or until plaster has dried.

C. Avoid conditions that result in plaster drying out too quickly.

1. Distribute heat evenly; prevent concentrated or uneven heat on plaster.
2. Maintain relative humidity levels for prevailing ambient temperature that produce normal drying conditions.
3. Ventilate work areas in a manner that prevents drafts of air from contacting surfaces during plaster application and until plaster is dry.

PART 2 - PRODUCTS

2.1 LIME-PLASTER MATERIALS

A. Hydrated Lime: ASTM C 206, Type S or Type N.

B. Lime Putty: Slaked hydrated lime or factory-prepared lime putty according to ASTM C 1489.

C. Sand Aggregates: ASTM C 897.

1. Finish-Coat Sand: Match size, texture, and gradation of existing sand as closely as possible. Blend several sands if necessary to achieve suitable match.

D. Fiber: 1/2 to 1 inch (13 to 25 mm) in length; composed of natural linen, cotton, hemp, or jute fiber or alkali-resistant glass or polypropylene fiber; free of grease, waxes, and oils; and beaten well to separate fibers before blending into unfibered plaster material.

1. Proportion of Fiber to Unfibered Plaster Material: 3.5 oz./cu. ft. (3.5 g/L) of unfibered plaster material, adjusted as required to produce a well-fibered, cohesive, spreadable, stiff mix with fibers uniformly distributed.

2.2 GYPSUM PLASTER MATERIALS

A. Gypsum Materials:

1. Lightweight Gypsum Ready-Mixed Plaster: ASTM C 28/C 28M, with mill-mixed perlite aggregate.
2. Gypsum Neat Plaster: ASTM C 28/C 28M for use with job-mixed aggregates.
3. Gypsum Wood-Fibered Plaster: ASTM C 28/C 28M.
4. High-Strength Gypsum Neat Plaster: ASTM C 28/C 28M; with a minimum, average, dry compressive strength of 2800 psi (19 MPa) per ASTM C 472 for a mix of 100 lb (45 kg) of plaster and 2 cu. ft. (0.06 cu. m) of sand.
5. Gypsum Gaging Plaster. ASTM C 28/C 28M.
6. High-Strength Gypsum Gaging Plaster: ASTM C 28/C 28M; with a minimum, average, dry compressive strength of 5000 psi (34 MPa) per ASTM C 472 for a neat mix.
7. Gypsum Ready-Mixed Finish Plaster: ASTM C 28/C 28M; manufacturer's standard, mill-mixed, gaged, interior finish.

8. Gypsum Keene's Cement: ASTM C 61/C 61M.

B. Hydrated Lime: ASTM C 206, Type S or Type N.

C. Aggregates:

1. Aggregate for Base-Coat Plasters: ASTM C 35, sand.
2. Aggregate for Float Finishes: ASTM C 35, sand; graded per ASTM C 842.

D. Fiber: 1/2 to 1 inch (13 to 25 mm) in length; composed of natural linen, cotton, hemp, or jute fiber; or glass or polypropylene fiber; free of grease, waxes, and oils; and beaten well to separate fibers before blending into unfibered plaster material.

1. Proportion of Fiber to Unfibered Plaster Material: 3.5 oz./cu. ft. (3.5 g/L) of unfibered plaster material, adjusted as required to produce a well-fibered, cohesive, spreadable, stiff mix with fibers uniformly distributed.

E. Bonding Compound: ASTM C 631.

2.3 LATH

A. Wood Lath: 1/4 inch by 1-1/4 inch (6 mm by 32 mm) sound, straight-grained, wood strips

B. Metal Lath:

1. Expanded-Metal Lath: ASTM C 847, cold-rolled carbon-steel sheet, ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coated.

a. Paper Backing: Kraft paper factory bonded to back of lath.
b. Diamond-Mesh Lath: Flat, 2.5 lb/sq. yd. (1.4 kg/sq. m).
c. Flat Rib Lath: Rib depth of not more than 1/8 inch (3 mm), 2.75 lb/sq. yd. (1.5 kg/sq. m)
d. 3/8-Inch (9.5-mm) Rib Lath: 3.4 lb/sq. yd. (1.8 kg/sq. m).

2.4 TRIM ACCESSORIES

A. General: According to ASTM C 1063 for lime plaster and ASTM C 841 for gypsum plaster; coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:

1. Cornerite: Fabricated from expanded-metal lath with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
2. Striplath: Fabricated from expanded-metal lath with ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized zinc coating.
3. Cornerbeads: Fabricated from zinc or zinc-coated (galvanized) steel.

a. Small nose cornerbead with expanded flanges; use unless otherwise indicated.
b. Small nose cornerbead with perforated flanges; use on curved corners.
c. Small nose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing unit masonry corners.
d. Bull nose cornerbead, radius of 3/4 inch (19 mm) minimum, with expanded flanges; use at locations indicated on Drawings.

4. Casing Beads: Fabricated from zinc or zinc-coated (galvanized) steel; square-edged style; with expanded flanges.
5. Control Joints: Fabricated from zinc or zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.

6. Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
7. Two-Piece Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; formed to produce slip-joint and square-edged reveal that is adjustable from 1/4 to 5/8 inch (6 to 16 mm) wide; with perforated flanges.

2.5 MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fasteners for Attaching Lath to Substrates:

1. For Lime Plaster: ASTM C 1063.
2. For Gypsum Plaster: ASTM C 841.
3. For Wood Lath: ASTM C 841 requirements for wood-floor-runner or wood-furring fasteners unless otherwise indicated on Drawings.

C. Wire Ties: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch (1.21-mm) diameter, unless otherwise indicated.

D. Plaster-Stabilization Materials: Acrylic emulsion(s) and related installation products shall have proven effectiveness in reattaching delaminated plaster and shall have been used previously by historic treatment specialist with successful results.

1. Acrylic Emulsion(s), General: Aqueous emulsion(s) of acrylic polymer, adhesive to plaster and plaster substrates, nontoxic, and non-reemulsifiable after curing.
2. Prewet Solution: Low-viscosity acrylic emulsion.
3. Adhesive: Thickened acrylic emulsion; thickener as recommended in writing by resin manufacturer and historic treatment specialist.

E. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.
2. Little possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could do the following:

a. Remove, alter, or in any way harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in contract.
b. Leave an unintended residue on surfaces.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT OF PLASTER, GENERAL

A. Historic Treatment Appearance Standard: Completed work is to have a uniform appearance as viewed by Architect from building interior at 5 feet (1.5 m) away from surface and from building exterior at 20 feet (6 m) away from surface.

B. General: In treating historic plaster, disturb it as minimally as possible and as follows unless otherwise indicated:

1. Dismantle loose, damaged, or deteriorated plaster, lath, and support systems that cannot be repaired.
2. Verify extent of plaster deterioration against that indicated on Drawings. Consult Architect on types and extent of required work.
3. Verify that substrate surface conditions are suitable for repairs.

4. Provide lath, furring, and support systems for plaster included in the work of this Section.
5. Leave repaired plasterwork in proper condition for painting or applying other finishes as indicated.
6. Install temporary protective measures to protect historic surfaces that shall be treated later.

C. Illumination: Perform plastering work with adequate, uniform illumination that does not distort the flatness or curvature of surfaces.

3.2 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate and environmental conditions, installation tolerances, and other conditions affecting performance of the Work.

1. If existing substrates cannot be prepared to an acceptable condition for plastering work, notify Architect in writing.
2. Notify Architect of undocumented detrimental conditions including cracks, bulges, loose backup, rotted wood, rusted metal, and other deteriorated items.

B. Masonry Substrates: Verify that mortar joints are struck flush. Notify Architect of undocumented masonry substrate without flush joints. Proceed with plastering as directed by Architect.

C. Begin historic plastering work only after unsatisfactory conditions have been corrected.

3.3 PREPARATION FOR PLASTERING

A. Substrates: Prepare according to plaster manufacturer's written instructions and as follows:

1. Clean surfaces to remove dust, loose particles, grease, oil, incompatible curing compounds, form-release agents, and other foreign matter and deposits that could impair bond with plaster.
2. Remove ridges and protrusions greater than 1/8 inch (3 mm) and fill depressions greater than 1/4 inch (6 mm) with patching material. Allow to set and dry.

3.4 PLASTER REMOVAL AND REPLACEMENT, GENERAL

A. Dismantle plaster that is damaged or deteriorated to the limits indicated. Carefully dismantle areas along straight edges that lie over supports, without damaging surrounding plasterwork.

B. Maintain lath and supporting members in an undamaged condition so far as practicable. Dismantle damaged lath and supports that cannot be repaired or resecured and replace with new work of same type.

C. Notify Architect of undocumented detrimental conditions including cracks, bulges, loose backup, rotted wood, rusted metal, and other deteriorated items.

D. Do not deviate more than plus or minus 1/8 inch in 10 feet (3 mm in 3 m) from a true plane in finished plaster surfaces, as measured by a 10-foot (3-m) straightedge placed on surface.

E. Clean substrate surfaces to remove grease, waxes, oils, waterborne staining, debris, and other foreign matter and deposits that could impair bond with repair material.

F. Wet wood lath, masonry, and, concrete bases before plaster application. Keep substrate damp to the touch but without visible water droplets.

G. Wet remaining plaster abutting the replacement plaster before installing new plasterwork.

H. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.

I. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

3.5 FLAT LIME-PLASTER REMOVAL AND REPLACEMENT

A. General: Dismantle deteriorated plaster to existing sound plaster at locations indicated on Drawings.

1. Inspect for lath deterioration. If any, replace lath.
2. Sand bonding surfaces of repair area, and clean the surface with a nonmetallic bristle brush.
3. Wet substrate to damp condition, but without visible water droplets, then install new plaster to original profiles.

B. Lime-Plaster Base Coats:

1. Scratch Coat: 1 part lime putty, 2-1/2 parts base-coat sand.
2. Brown Coat: 1 part lime putty, 3 parts base-coat sand.

C. Lime-Plaster Finish Coats:

1. Finish-Coat Mix for Smooth-Troweled Finish: As required to match existing finish.
2. Finish-Coat Mix for Smooth-Float Finish: As required to match exiting finish.
3. Finish-Coat Mix for Sandy Float Finish: As required to match existing finish.

D. Lime-Plaster Finishes: Match finish(es) of existing.

1. Provide smooth-troweled finish where indicated. Apply in two layers totaling 1/8 inch (3 mm) thick.
2. Provide smooth-float finish where indicated. Apply in two layers totaling 1/8 inch (3 mm) thick.
3. Provide sandy-float finish where indicated. Apply in two layers totaling 1/8 inch (3 mm) thick.

E. Hairline cracking within the plaster or plaster separation at edge of a replacement is unacceptable. Completely dismantle such work and reinstall or repair as a crack repair.

3.6 FLAT GYPSUM-PLASTER REMOVAL AND REPLACEMENT

A. General: Dismantle deteriorated plaster to existing sound plaster at locations indicated on Drawings. Use replacement plaster mixes of gypsum, lime, and aggregate; and application according to ASTM C 842 unless otherwise indicated.

1. Inspect for lath deterioration. If any, replace lath.
2. Sand bonding surfaces of repair area, and clean the surface with a nonmetallic bristle brush.
3. Wet substrate to damp condition, but without visible water droplets, then install new plaster to original profiles.

B. Bonding Compound: Apply on unit masonry and concrete plaster bases.

C. Gypsum-Plaster Base Coats:

1. Base Coats over Wood Lath: Gypsum neat plaster with job-mixed sand and fiber.
2. Base Coats over Expanded-Metal Lath: High-strength gypsum plaster with job-mixed sand for scratch and brown coats.
3. Base Coats over Expanded-Metal Lath:

   a. Scratch Coat: Gypsum wood-fibered plaster; neat or with job-mixed sand.
   b. Brown Coat: Gypsum lightweight ready-mixed plaster.

4. Base Coats over Unit Masonry: Gypsum lightweight ready-mixed plaster.
5. Base-Coat Mix over Monolithic Concrete: Gypsum neat plaster with job-mixed sand.

D. Gypsum-Plaster Finish Coats: Match finish(es) of existing

1. Finish-Coat Mix for Smooth-Troweled Finishes: Gypsum ready-mixed finish plaster.
2. Finish-Coat Mix for Float Finishes: Gypsum gaging plaster.

3. Finish-Coat Mix for Textured Finishes: Gypsum ready-mixed finish plaster.

E. Gypsum-Plaster Finishes: Match finish(es) of existing.

1. Provide troweled finish where indicated.
2. Provide float finish where indicated.
3. Provide textured finish where indicated.

3.7 REMOVING AND INSTALLING LATH AND ACCESSORIES

A. General: Dismantle existing plaster as necessary to expose deteriorated or rusted lath, wire ties, and support system, back to firm substrates and supports. Repair with new materials, well secured to existing lath in good condition and to building structure.

1. Cutting: Cut lath so it can be taken out completely from one support to the next. Cut to avoid cracking surrounding plaster.
2. Cut out existing base-coat plaster beyond the edges of the new lath to permit new plaster to extend onto the old lath. Then step subsequent plaster coats to permit new plaster to extend over the old material.
3. Fasten new lath to support system and to good existing lath. Wire tie at least every 6 inches (150 mm).
4. Install new lath according to ASTM C 1063 for lime plaster and ASTM C 841 for gypsum plaster.

B. Notify Architect of undocumented detrimental conditions including cracks, bulges, loose backup, rotted wood, rusted metal, and other deteriorated items.

C. Wood Lath: Install wood lath in same orientation and spacing as remaining wood lath and with lath ends supported by furring or framing. Stagger ends of adjacent laths over different supports, not aligned, and secure with fasteners at each end and spaced a maximum of 24 inches (610 mm) o.c. into supports.

D. Metal Lath: Install according to ASTM C 1063 for lime plaster and ASTM C 841 for gypsum plaster.

1. Partition Framing and Vertical Furring: Install flat diamond-mesh lath.
2. Flat-Ceiling and Horizontal Framing: Install flat diamond-mesh lath.
3. Curved-Ceiling Framing: Install flat diamond-mesh lath.
4. On Solid Surfaces, Not Otherwise Furred: Install self-furring, diamond-mesh lath.

3.8 PATCH-TYPE REPAIR

A. General: Patch voids, fractured surfaces, and crushed areas in otherwise sound plaster that are larger than cracks at locations indicated on Drawings.

1. Notify Architect of undocumented detrimental conditions including cracks, bulges, loose backup, rotted wood, rusted metal, and other deteriorated items.
2. Inspect for deterioration of supporting plaster and lath, and repair or replace deteriorated material as required for a sound substrate.
3. Rake perimeter of hole to sound plaster, and slightly undercut existing plaster to enable replacement plaster to tuck behind existing plaster.
4. Replace missing lath in kind. Bridge gaps in wood lath with expanded-metal lath, overlapping wood by 6 inches (150 mm) and fastening them together.
5. Clean hole to remove loose materials and other foreign matter and deposits that could impair bond with repair material. Where grease, waxes, oils, waterborne staining, or other foreign matter and deposits that could impair bond with repair material have penetrated into the plaster, enlarge the hole to remove these deposits.
6. Wet substrate to damp condition, but without visible water droplets, then install patch material to original profiles.
7. Maintain adjacent plasterwork in an undamaged condition so far as practicable.

B. Lime-Plaster Mix: Repair mix demonstrated in mockup.

C. Gypsum-Plaster Mix: Gypsum neat plaster with job-mixed sand, applied in two coats with fiber in first coat.

D. Finishing: Finish flat surfaces flush and with same texture as adjacent existing plaster.

E. Hairline cracking within the plaster or plaster separation at edge of a patch is unacceptable. Completely dismantle such work and reinstall or repair.

3.9 HAIRLINE CRACK REPAIR

A. General: Repair cracks 1/32 inch (1 mm) in width or narrower in otherwise sound plaster at locations indicated on Drawings.

1. Notify Architect of undocumented detrimental conditions including cracks, bulges, loose backup, rotted wood, rusted metal, and other deteriorated items.
2. Maintain adjacent plasterwork in an undamaged condition so far as practicable.

B. Existing Topcoat: Open crack in existing topcoat to at least 1/8 inch (3 mm) in width and check for broken fiber reinforcement in base coats.

C. Existing Base Coats: Do not open crack wider in existing base coats unless inspection or other indication shows that the fiber reinforcement has broken. Where inspections indicate failure of fiber reinforcement, proceed as for a large crack repair, but only for length of crack with broken fiber reinforcement.

D. Clean out crack to remove loose materials and other foreign matter and deposits that could impair bond with repair material. Where grease, waxes, oils, waterborne staining, or other foreign matter and deposits that could impair bond with repair material have penetrated into the topcoat plaster, widen the crack and sand surface of the exposed basecoat to remove these deposits.

E. Wet substrate to damp condition, but without visible water droplets.

F. Force finish-coat plaster without aggregate into crack, filling crack to original plaster profile.

G. Finishing: Finish flat surfaces flush and with same texture as adjacent existing plaster.

3.10 LARGE CRACK REPAIR

A. General: Repair cracks over 1/32 inch (1 mm) in width in otherwise sound plaster at locations indicated on Drawings.

1. Notify Architect of undocumented detrimental conditions including cracks, bulges, loose backup, rotted wood, rusted metal, and other deteriorated items.
2. Maintain adjacent plasterwork in an undamaged condition so far as practicable.

B. Open crack to at least 1/8 inch (3 mm) in width and full depth with V-groove tool, and check for bond separation or lath deterioration.

C. Abrade side surfaces of crack and remove inner crack debris by gouging (keying) the inside area of the crack.

D. Clean out crack to remove loose materials and other foreign matter and deposits that could impair bond with repair material. Where grease, waxes, oils, waterborne staining, or other foreign matter and deposits that could impair bond with repair material have penetrated into the plaster, widen the crack to remove these deposits.

E. Wet substrate to damp condition, but without visible water droplets.

F. Install finish-coat plaster to fill crack to original plaster profile.

G. Finishing: Finish flat surfaces flush and with same texture as adjacent existing plaster.

H. Offset Cracks: If the crack is offset in surface plane by more than 1/8 inch (3 mm), dismantle the plaster on each side of the crack, a minimum width of 6 inches (150 mm) and down to the lath or other substrate. Then, repair as specified for flat-plaster removal and replacement.

3.11 REATTACHMENT OF DELAMINATED PLASTER

A. General: Reattach plaster that has detached from its wooden lath at locations indicated on Drawings.

1. Notify Architect of undocumented detrimental conditions including cracks, bulges, loose backup, rotted wood, rusted metal, and other deteriorated items.
2. Maintain adjacent plasterwork in an undamaged condition so far as practicable.

B. Verify extent of detachment of plaster that has not yet fallen by tapping on plaster surface and evaluating the hollow or solid resonance.

C. Protect floors from spillage and debris in the vicinity of work. Use materials resistant to the passage of fluids used in work.

D. Drill 1/4-inch (6-mm) injection ports (holes) through the plaster spaced 3 to 6 inches (75 to 150 mm) apart over surface of detached plaster. Dislodge loose plaster particles, and vacuum debris from holes.

E. Prewet injection ports, gaps at edges of lost plaster, back of plaster, and wooden lath with prewet solution.

F. Inject adhesive into ports, enough to fill gaps between detached plaster and lath, and inject into gaps at edges of lost plaster.

G. Clean off excess and smeared adhesive while wet.

H. Apply temporary battens over surface of treated plaster to prevent further separation during repair work. Secure battens in place against plaster with screws through the battens and plaster and into the wood lath.

I. Maintain temporary battens in place for a week or more, allowing adhesive to coalesce and dry.

J. Remove battens, patch holes and missing plaster, and repair cracks.

3.12 INSTALLATION TOLERANCES

A. Completed plaster installation shall not deviate from a true plane by more than 1/8 inch (3 mm) as measured by a 5-foot (1.5-m) straightedge placed at any location on a surface, except where existing plaster is retained as a substrate for new plasterwork.

3.13 CLEANING AND PROTECTION

A. Protect work of other trades against damage. Promptly remove plaster from surfaces not indicated to be repaired or plastered. Do not scratch or damage finished surfaces.

B. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

C. Correct damage to other historic surfaces and to new work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. Remove temporary protection and enclosure of other work.

END OF SECTION 09 03 20

SECTION 09 21 16.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Gypsum board shaft wall assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each specified system and assembly, including components and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: From ICC-ES showing compliance with Project requirements, for the following:

1. Studs and track.
2. Equivalent corrosion-resistant coating on steel framing.
3. Firestop track.
4. Post-installed anchors.
5. Power-actuated fasteners.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage.

B. Stack shaftliner and face panels flat and support them on risers on a flat platform to prevent sagging.

C. Protect steel framing from corrosion, deformation, and other damage during delivery, storage, and handling in accordance with AISI S202.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Comply with gypsum-shaftliner-board manufacturer's written instructions.

B. Do not install finish panels until installation areas are enclosed and conditioned.

C. Do not install shaftliner and face panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to rated assembly indicated on Drawings tested in accordance with ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: Provide materials and construction identical to rated assembly indicated on Drawings tested in accordance with ASTM E90 and classified in accordance with ASTM E413 by a testing and inspecting agency.

2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

A. Gypsum Board Shaft Wall Assembly :

1. Fire-Resistance Rating: As indicated on Drawings.
2. Minimum STC Rating: As indicated on Drawings.
3. Gypsum Shaftliner Board: Moisture- and Mold-Resistant Type X Liner Panels

a. Finish Panels: Gypsum board as specified in Section 092900 "Gypsum Board."

4. Steel Framing: Comply with applicable requirements in accordance with AISI S220 and with requirements for fire-resistance-rated assemblies indicated on Drawings. [**Include firestop track**].

a. Studs: Profiles required for fire-resistance-rated assembly indicated on Drawings for repetitive, corner, and end members as follows:

1) Depth: As indicated on Drawings.
2) Minimum Base-Steel Thickness: 0.0329 inch.

b. Track: J-profile track required for fire-resistance-rated assembly indicated on Drawings with minimum long-leg length of 2 inches and matching studs in depth.

1) Minimum Base-Steel Thickness: 0.0329 inch.

5. Sound Attenuation Blankets: As specified in Section 072100 "Thermal Insulation."

2.3 ACCESSORIES

A. Provide accessories that comply with shaft wall manufacturer's written instructions.

B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with shaft wall assembly manufacturer's written instructions for application indicated on Drawings.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated on Drawings.

D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.

1. Expansion Anchors: Fastener systems with an evaluation report, acceptable to authorities having jurisdiction, based on ICC-ES AC01 or AC193 as appropriate for the substrate.

E. Reinforcing: Steel reinforcing strips of corrosion-resistant steel complying with steel framing requirements and in 0.0329-inch minimum base-steel thickness.

F. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

G. Gypsum Board Cants:

1. Gypsum Board Panels: As specified in Section 092900 "Gypsum Board," Type X, 1/2- or 5/8-inch panels.
2. Adhesive: Laminating adhesive as specified in Section 092900 "Gypsum Board."
3. Non-Structural Steel Framing: As specified in Section 092216 "Non-Structural Metal Framing."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine shaftliner and face panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or top track to surfaces indicated to receive sprayed fire-resistive materials unless otherwise indicated on Drawings. Where offset anchor plates are required, provide continuous plates fastened to building structure as required by fire-resistance-rated assembly but not more than 24 inches o.c.
2. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated on Drawings. Protect remaining fire-resistive materials from damage.
3. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 078100 "Applied Fire Protection."

3.3 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace shaftliner and face panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 21 16.23

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

B. Related Sections include the following:

1. Division 05 Section "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.
2. Division 07 Section "Building Insulation" for insulation installed with Z-shaped furring members.
3. Division 07 Section "Fire-Resistive Joint Systems" for head-of-wall joint systems installed with non-load-bearing steel framing.
4. Division 09 Section "Gypsum Board."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated,

B. Steel Studs and Runners:

1. Minimum Base-Metal Thickness: 0.0312 inch (0.79 mm].
2. Depth: As indicated on Drawings.

C. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (50.8-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.

2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (50.8-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

    a. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

        1) Steel Network Inc. (The); VertiTrack VTD Series.
        2) Superior Metal Trim; Superior Flex Track System (SFT).

D. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
    b. Metal-Lite, Inc.; The System.

E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.027 inch (0.7 mm).

F. Cold-Rolled Channel Bridging: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges.

1. Depth: 1-1/2 inches (38.1 mm) unless indicated otherwise.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38.1 by 38.1 mm), 0.068-inch- (1.73-mm-) thick, galvanized steel.

G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).
2. Depth: 1-1/2 inches (38.1 mm) unless indicated otherwise.

H. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical or hat shaped.

I. Cold-Rolled Furring Channels: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges.

1. Depth: 3/4 inch (19.1 mm).
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of 0.0312 inch (0.79 mm).
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.

J. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare-metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEM COMPONENTS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.

B. Hanger Attachments to Concrete:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.

a. Type: Postinstalled, expansion anchor.

2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch (4.12-mm) diameter.

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (1.37mm) and minimum 1/2 –inch-(12.7-mm-) wide flanges.

1. Depth: 1 ½” of as indicated on Drawings.

E. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges, 3/4 inch (19.1 mm) deep.

2. Steel Studs: ASTM C 645.

a. Minimum Base-Metal Thickness: 0.0312 inch (0.79 mm).
b. Depth: As indicated on Drawings.

3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.2 mm) deep.

a. Minimum Base Metal Thickness: 0.0312 inch (0.79 mm).

4. Resilient Furring Channels: 1 1/2-inch- (38.1-mm-) deep members designed to reduce sound transmission.

a. Configuration: Asymmetrical or hat shaped.

F. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Armstrong World Industries, Inc.; Drywall Grid Systems.
b. Chicago Metallic Corporation; Drywall Furring System.
c. USG Corporation; Drywall Suspension System.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide[one of] the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (600 mm) o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Install studs so flanges within framing system point in same direction.

1. Space studs as follows:

a. Single-Layer Application: 16 inches (406 mm) o.c., unless otherwise indicated.
b. Multilayer Application: 16 inches (406 mm) o.c., unless otherwise indicated.
c. Tile backing panels: 16 inches (406 mm) o.c., unless otherwise indicated.

C. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

D. Install studs so flanges within framing system point in same direction.

E. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.

2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

a. Install two studs at each jamb, unless otherwise indicated.
b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (12.7-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

F. Direct Furring:

1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

G. Z-Furring Members:

1. Erect insulation (specified in Division 07 Section "Thermal Insulation") vertically and hold in place with Z-furring members spaced [24 inches (610 mm)] [600 mm] o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (600 mm) o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (300 mm) from corner and cut insulation to fit.

H. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components in sizes and spacing indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

1. Hangers: 48 inches (1219 mm) o.c.
2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

   a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

   a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09 22 16

SECTION 09 25 23 - LIME-BASED PLASTERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Non-metallic lath.
2. Preformulated dry-mix lime plaster.
3. Preformulated lime-putty plaster.

B. Related Requirements:

1. Section 09 03 20 "Historic Treatment of Plaster" for repair and replacement of historic lime plastering.
2. Section 09 22 16 "Non-Structural Metal Framing" for non-load-bearing steel framing and furring that support plaster bases and lime-based plaster.
3. Section 09 26 13 "Gypsum Veneer Plastering" for gypsum-based veneer plastering.
4. Section 09 29 00 "Gypsum Board" for panels to receive interior lime-based plaster.
5. Section 09 91 13 "Exterior Painting" for breathable exterior coatings applied over exterior lime-based plasterwork.
6. Section 09 91 23 "Interior Painting" for breathable interior coatings applied over interior lime-based plasterwork.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to plasterwork including, but not limited to, the following:

a. Verify Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
b. Materials, material application, colors, surface finishes, and sequencing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of specified product.

1. Include recommendations for product application and use.

B. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors and textures for each type of exposed finish.

C. Samples for Verification: Actual sample of plaster systems for each type of exposed finish.

1. Size: 12 by 12 inches.

1.5 INFORMATIONAL SUBMITTALS

A. Research Reports: For self-furring fiberglass lath, from [an agency acceptable to authorities having jurisdiction indicating code compliance.

B. Qualification Statements: For Installer.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For lime-based plaster finishes.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Entity that employs plaster applicators and supervisors with expertise in applying lime-based plasterwork types required. Experience in only applying gypsum-based or cement plasterwork, applying veneer plaster, or installing gypsum board is insufficient experience.

1.8 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup as indicated on Drawings.
2. Simulate finished lighting conditions for review of mockups.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of product.

B. Store materials on elevated platforms, under covers, and in dry locations with ambient temperatures continuously maintained at not less than 45 deg F.

C. Store plaster materials in manufacturer's original and unopened containers. Discard damaged containers or those opened for longer than recommended in writing by manufacturer.

1.10 FIELD CONDITIONS

A. Comply with lime-based plaster manufacturers' written instructions.

B. Maintain temperatures in work areas at not less than 45 deg F or greater than 80 deg F for at least seven days before application of plaster, continuously during application, and until plaster has dried.

C. Avoid conditions that result in plaster drying out too quickly.

1. Distribute heat evenly; prevent concentrated or uneven heat on plaster.
2. Maintain relative humidity levels for prevailing ambient temperatures that produce normal drying conditions.
3. Ventilate work areas to prevent drafts of air from contacting surfaces during plaster application and until plaster is dry.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. For materials and products, obtain each type and variety from single manufacturer or producer.

2.2 NON-METALLIC LATH

A. Self-Furring Fiberglass Lath: ASTM C1788; alkaline-resistant fiberglass lath fabricated with three-dimensional leno weave; recommended in writing by lime-based plaster manufacturer for application indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Lime Works.US
    b. Saint-Gobain ADFORS
    c. Sika Corporation
    d. Smarter Building Systems LLC
    e. SpiderLath

2. Nominal Weight: 8.8 oz./sq. yd..
3. Nominal Thickness: 1/4 inch][3/8 inch.
4. Minimum Tensile Strength:

    a. Warp: 330 lbf/in.
    b. Weft: 310 lbf/in.

B. Cornerbeads: PVC with perforated flanges; small-nose type.

C. Casing Beads: PVC with perforated flanges; square-edge style in depth and flange length required to suit applications indicated.

D. Fasteners for Fiberglass Lath: ASTM C1787; corrosion- and alkaline-resistant metal fasteners appropriate for substrate indicated.

1. Material: Coated steel recommended in writing by lime-based plaster manufacturer for application indicated.

E. Anchor Plates: ASTM C1787; alkaline-resistant, perforated plastic washers with minimum diameter recommended in writing by lath manufacturer, but not less than 1-3/4 inches.

2.3 PREFORMULATED PLASTER

A. Preformulated Dry-Mix Lime Plaster:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. BioLime LLC
    b. ecostucco; Mediterranean Colors, LLC
    c. KEIM Mineral Coatings of America, Inc.
    d. Lime Works.US
    e. Texston Architectural Surfaces
    f. TransMineral, USA; subsidiary of Saint-Astier
    g. U.S. Heritage Group, Inc.
    h. Vasari Lime Plaster & Paint

2. System Description: Manufacturer's complete system of factory-blended, dry-mix, lime-based plaster formulations that are recommended in writing by manufacturer for substrates indicated; containing no hydraulic cement.

    a. Lime: ASTM C206 non-hydraulic hydrated lime, Type N or Type S
    b. Aggregates: ASTM C897 sand.

3. Bond-Coat Plaster: Manufacturer's high-adhesion, lime-based bond coat recommended in writing for substrates and finish coats indicated.
4. Base/Filler-Coat Plaster: Manufacturer's lime-based mortar recommended in writing for substrates and finish coats indicated.
5. Finish-Coat Plaster: Manufacturer's lime-based, finish-coat plaster recommended in writing for substrate indicated.

a. Maximum Particle Size: 12 mils.
b. Pigments: Manufacturer's standard, UV- and alkali-stable mineral pigments.
c. Color: As selected from manufacturer's full range.

B. Preformulated Lime-Putty Plaster:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. BioLime LLC
b. ecostucco; Mediterranean Colors, LLC
c. FirmoLux
d. Lime Works.US
e. Texston Architectural Surfaces
f. U.S. Heritage Group, Inc.
g. Valentino Decorative Finishes
h. Vasari Lime Plaster & Paint

2. System Description: Manufacturer's complete system of factory-blended lime-putty (pre-wet) plaster formulations that are recommended in writing by manufacturer for substrates indicated. [Acrylate and synthetic polymer content limited to 10 percent of the total mix]<Insert requirements> .
3. Primer: Manufacturer's standard primer recommended in writing by manufacturer for substrate and subsequent plaster coats indicated.
4. Base-Coat Plaster: Lime-putty formulation recommended in writing by manufacturer for substrate and finish-coat plaster indicated.
5. Finish-Coat Plaster: Manufacturer's mixture of ground lime, aggregates, and organic binders and resins recommended for substrate indicated.

a. Finish Type: Match existing plaster.
b. Lime: Manufacturer's standard hydrated lime putty.
c. Aggregates: Manufacturer's standard for finish type indicated.

1) Maximum Particle Size: 8 mils.

d. Pigments: Manufacturer's standard, UV- and alkali-stable mineral pigments.
e. Color: As selected from manufacturer's full range.
f. Gloss: Match existing..

2.4 MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster or lath.

B. Fiber Reinforcement: Hemp, 1/2 inch long, free of contaminants recommended in writing by lime-based plaster manufacturer for adding to scratch- and base-coat preformulated dry-mix plaster.

C. Mesh Reinforcement: Glass-fiber mesh recommended in writing by lime-based plaster manufacturer for substrate and plaster system indicated.

D. Sealer: Penetrating type that does not produce a surface film.

1. Exterior, Preformulated Dry-Mix Lime Plaster: Breathable, catalyzed, siliconate solution. recommended in writing by lime-based plaster manufacturer for plaster system indicated.
2. Preformulated Lime-Putty Plaster: Solvent-based paste/wax recommended in writing by lime-based plaster manufacturer for plaster system indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

B. Prepare substrates for plaster application in accordance with lime-based plaster manufacturer's written instructions.

3.3 INSTALLATION OF NON-METALLIC LATH

A. Self-Furring Fiberglass Lath: Install in accordance with ASTM C1787 and with lath manufacturer's written instructions.

1. Install flat and free of creases and wrinkles.
2. Overlap lath seams as recommended in writing by manufacturer.
3. Do not end lath at corners. Lap internal and external corners with lath to the next framing member, but not less than 16 inches.

B. Cornerbeads: Install in accordance with manufacturer's written instructions.

C. Casing Beads: Install in accordance with manufacturer's written instructions.

1. Install to separate metal where it abuts plaster and in locations indicated on Drawings.

3.4 APPLICATION OF PREFORMULATED DRY-MIX LIME PLASTER

A. Mix and apply preformulated dry-mix lime plasters in accordance with lime-based plaster manufacturer's written instructions for substrates and systems indicated.

1. Follow manufacturer's written instructions for periods between coat applications and for maintaining environmental conditions and protection after final coat is applied.
2. Add fiber reinforcement to first- and second-coat mixes, but not finish-coat mixes, if recommended in writing by lime-based plaster manufacturer.
3. Finish plaster flush with built-in items that act as a plaster ground unless otherwise indicated on Drawings.

a. Where plaster terminates at metal, separate metal and plaster as indicated on Drawings.

B. Plaster on Self-Furring Fiberglass Lath: Apply plaster to provide finish to match existing.

1. Mesh Reinforcement: Embed in specific plaster coat recommended in writing by lime-based plaster manufacturer.
2. First Coat: Base/filler-coat plaster, 3/8 inch thick
3. Second Coat: Base/filler-coat plaster, 3/8 inch thick .
4. Finish Coat: Finish-coat plaster, 3/16 inch thick.

C. Brick Substrates, Lime Slurry Application: Provide finish to match existing.

1. First Coat: Bond-coat plaster, 1/8 inch thick.
2. Finish Coat: Finish-coat plaster, 1/8 inch thick.

D. Brick Substrates, Three-Coat Plaster Application: Provide finish to match existing.

1. Mesh Reinforcement: Embed in specific plaster coat recommended in writing by lime-based plaster manufacturer.
2. First Coat: Bond-coat plaster, 1/4 inch thick.
3. Second Coat: Base/filler-coat plaster, 1/4 inch thick.
4. Finish Coat: Finish-coat plaster, 1/4 inch thick.

E. Concrete Masonry Unit Substrates: Apply plaster to provide finish to match existing.

1. Mesh Reinforcement: Embed in specific plaster coat recommended in writing by lime-based plaster manufacturer.
2. First Coat: Bond-coat plaster, 3/8 inch thick.
3. Second Coat: Base/filler-coat plaster, 1/4 inch thick.
4. Finish Coat: Finish-coat plaster, 1/4 inch thick.

F. Cement Board Substrates: Apply plaster to provide finish to match existing .

1. Mesh Reinforcement: Embed in specific plaster coat recommended in writing by lime-based plaster manufacturer.
2. First Coat: Bond-coat plaster, 1/4 inch thick.
3. Second Coat: Base/filler-coat plaster, 1/4 inch thick.
4. Finish Coat: Finish-coat plaster, 1/4 inch thick.

G. Interior Gypsum Board Substrates: Apply plaster to provide finish to match existing.

1. Mesh Reinforcement: Embed in specific plaster coat recommended in writing by lime-based plaster manufacturer.
2. First Coat: Bond-coat plaster, 1/4 inch thick.
3. Second Coat: Finish-coat plaster, 1/8 inch thick.
4. Finish Coat: Finish-coat plaster, 1/8 inch thick.

H. Sealer: Apply in accordance with manufacturer's written instructions.

3.5 APPLICATION OF PREFORMULATED LIME-PUTTY PLASTERS

A. Mix and apply preformulated lime-putty plasters in accordance with manufacturer's written instructions for substrates and systems indicated.

1. Follow manufacturer's written instructions for periods between coat applications and for maintaining environmental conditions and protection after final coat is applied.
2. Finish plaster flush with built-in items that act as a plaster ground unless otherwise indicated on Drawings.

a. Where plaster terminates at metal, separate metal and plaster as indicated on Drawings.

B. Interior Gypsum Board Substrates: Apply plaster to provide finish to match existing.

1. Primer: Apply primer in accordance with manufacturer's written instructions.
2. Finish Coats: Apply three finish coats in accordance with manufacturer's written instructions to provide surface finish indicated.

C. Brick Substrates: Apply plaster to provide finish to match existing .

1. Primer: Apply primer in accordance with manufacturer's written instructions.
2. Base Coat: Apply base-coat plaster in accordance with manufacturer's written instructions.

a. Apply additional base coats if necessary to provide a smooth surface.

3. Finish Coats: Apply: three finish coats in accordance with manufacturer's written instructions to provide surface finish indicated.

D. Sealer: Apply to final finish coat in accordance with manufacturer's written instructions.

3.6 INSTALLATION TOLERANCES

A. Do not deviate more than plus or minus 1/4 inch in 10 ft. from a true plane in finished plaster surfaces when measured by a 10-ft. straightedge placed on surface.

3.7 REPAIR

A. Repair or replace work to defects and where bond to substrate has failed.

B. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

3.8 CLEANING AND PROTECTION

A. Remove temporary protection and enclosure of other work after plastering is complete.

B. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered.

C. Maintain lime-based plasterwork in a clean, undamaged condition until construction activities are complete.

END OF SECTION 09 25 23

SECTION 09 26 13 - GYPSUM VENEER PLASTERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Gypsum veneer plaster and gypsum base for interior veneer plaster.

B. Related Requirements:

1. Section 09 03 20 "Historic Treatment of Plaster" for repair and replacement of historic gypsum plastering.
2. Section 092216 "Non-Structural Metal Framing" for non-load-bearing steel framing.
3. Section 09 25 23 "Lime-Based Plastering" for gypsum-based veneer plastering.
4. Section 09 29 00 "Gypsum Board" for panels to receive interior gypsum plaster.
5. Section 09 91 13 "Exterior Painting" for breathable exterior coatings applied over exterior gypsum plasterwork.
6. Section 09 91 23 "Interior Painting" for breathable interior coatings applied over interior gypsum plasterwork.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show locations, fabrication, and installation of control joints, reveals, and trim; include plans, elevations, sections, details of components, and attachments to other work.

C. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 10-inch (250-mm) length for each trim accessory.

1.4 QUALITY ASSURANCE

A. Mockups: Provide a full-thickness finish mockup for each type and finish of gypsum veneer plaster and substrate to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select representative surfaces and conditions for application of each type of gypsum veneer plaster and substrate.
2. Provide mockups of [ceilings] [and] [partitions] in sizes of at least 100 sq. ft. (9 sq. m).
3. Apply gypsum veneer plaster, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, and bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover, and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

C. Stack panels flat on leveled supports off floor or slab to prevent sagging.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C843 requirements or gypsum veneer plaster manufacturer's written recommendations, whichever are more stringent.

B. Room Temperatures: Maintain not less than 55 deg F (13 deg C) or more than 80 deg F (27 deg C) for seven days before application of [gypsum base and]gypsum veneer plaster, continuously during application, and after application until veneer plaster is dry.

C. Avoid conditions that result in gypsum veneer plaster drying too rapidly.

1. Distribute heat evenly; prevent concentrated or uneven heat on veneer plaster.
2. Maintain relative humidity levels, for prevailing ambient temperature, that produce normal drying conditions.
3. Ventilate building spaces in a manner that prevents drafts of air from contacting surfaces during veneer plaster application until it is dry.

D. Do not install panels that are wet, moisture damaged, mold damaged, or faded from overexposure to sunlight.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain gypsum veneer plaster products, including gypsum base for veneer plaster, joint reinforcing tape, and embedding material, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.3 GYPSUM VENEER PLASTER

A. One-Component Gypsum Veneer Plaster: ASTM C587, ready-mixed, smooth, finish-coat veneer plaster formulated for application directly over substrate without use of separate base-coat material.

1. Subject to compliance with requirements, provide USG Corporation, Diamond ® Veneer Finish, or comparable product by one of the following:

a. Gold Bond
b. National Gypsum Company

2.4 PANEL PRODUCTS

A. Panel Size: Provide panels in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

B. Gypsum Base for Veneer Plaster: ASTM C1396/C1396M.

1. As recommended by gypsum veneer plaster manufacturer for use applications indicated
2. Thickness: 1/2-inch min. or as indicated on drawings.

C. Gypsum Base for Veneer Plaster, Type X: ASTM C1396/C1396M.

1. As recommended by gypsum veneer plaster manufacturer for use applications indicated
2. Thickness: 5/8- inch min. or as indicated on drawings.

D. Backing Panels for Multilayer Applications: ASTM C1396/C1396M gypsum base or gypsum board, as recommended by gypsum veneer plaster manufacturer, for application method and thicknesses indicated.

1. Core: Matching face layer unless otherwise indicated.
2. Thickness: Matching face layer unless otherwise indicated.

2.5 TRIM ACCESSORIES

A. Standard Trim: ASTM C1047, provided or approved by manufacturer for use in gypsum veneer plaster applications indicated.

1. Material: Galvanized-steel sheet or aluminum-coated steel sheet
2. Shapes:

a. Cornerbead.
b. Bullnose bead.
c. LC-Bead: J-shaped; exposed long flange receives veneer plaster.
d. L-Bead: L-shaped; exposed long flange receives veneer plaster.
e. U-Bead: J-shaped; exposed short flange does not receive veneer plaster.
f. Curved-Edge Cornerbead: With notched or flexible flanges.
g. Control joints.

2.6 JOINT-REINFORCING MATERIALS

A. General: Comply with joint strength requirements in ASTM C587 and with gypsum veneer plaster manufacturer's written recommendations for each application indicated.

B. Joint Tape:

1. Gypsum Base for Veneer Plaster: As recommended by gypsum veneer plaster manufacturer for applications indicated.
2. Cementitious Backer Units: As recommended by cementitious backer unit manufacturer.
3. Gypsum Base for Veneer Plaster: As recommended by gypsum veneer plaster manufacturer for use with joint-tape material and gypsum veneer plaster applications indicated.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced product standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended by manufacturer for directly adhering gypsum-base, face-layer panels to backing-layer panels in multilayer construction.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

D. Sound Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing), produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant, complying with ASTM C834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E90.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLING PANELS, GENERAL

A. Gypsum Base for Veneer Plaster: Apply according to ASTM C844 unless manufacturer's written recommendations are more stringent.

1. Do not allow gypsum base to degrade from exposure to sunlight, as evidenced by fading of paper facing.
2. Erection Tolerance: No more than 1/16-inch (1.6-mm) offsets between planes of gypsum base panels, and 1/8 inch in 8 feet (3 mm in 2.4 m) noncumulative, for level, plumb, warp, and bow.

B. Install sound attenuation blankets before installing gypsum base for veneer plaster.

C. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

D. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.6 mm) of open space between panels. Do not force into place.

E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not locate joints, other than control joints, at corners of framed openings.

F. Attach panels to steel studs, so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

G. Attach panels to framing provided at openings and cutouts.

H. Form control joints with space between edges of adjoining panels.

I. Cover both sides of partition framing with panels in concealed spaces, including above ceilings, except in internally braced chases.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.74 sq. m) in area.
2. Fit panels around ducts, pipes, and conduits.
3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints; seal joints with acoustical sealant.

J. Wood Framing: Install panels over wood framing, with "floating" internal corner construction. Do not attach panels across the flat grain of wide-dimension lumber, including floor joists and headers. "Float" panels over these members or provide control joints to counteract wood shrinkage.

K. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

L. Fastener Spacing: Comply with ASTM C844, manufacturer's written recommendations, and fire-resistance-rating requirements.

1. Space screws a maximum of 12 inches (305 mm) o.c. along framing members for wall or ceiling application.

3.3 INSTALLING PANELS

A. Install panels for veneer plaster in locations indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum base panels before wall panels, to the greatest extent possible and at right angles to framing unless otherwise indicated.
2. On walls, apply gypsum base panels horizontally and perpendicular to framing unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

   a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
   b. At stairwells and other walls higher than 30 feet (9.0 m), install gypsum base panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-furring, apply gypsum base panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.

C. Multilayer Application on Ceilings: Apply backing panels for ceilings before applying backing panels for partitions; apply gypsum-base face layers in same sequence. Apply backing panels at right angles to framing members and offset gypsum-base, face-layer joints a minimum of 16 inches (400 mm) from parallel backing panel joints unless otherwise required by fire-resistance-rated assembly.

D. Multilayer Application on Partitions: Apply backing panels indicated and gypsum-base face layers vertically (parallel to framing), with joints of backing panels located over stud or furring members and gypsum-base, face-layer joints offset at least one stud or furring member from backing-panel joints, unless otherwise required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

1. Z-Furring: Apply backing panels vertically (parallel to framing) and gypsum-base face layer either vertically or horizontally (perpendicular to framing), with vertical joints offset at least one furring member. Locate edge joints of backing panels over furring members.

E. Fasteners: Drive fasteners flush with gypsum base surface. Do not overdrive fasteners or cause surface depressions.

F. Single-Layer Fastening Methods: Apply gypsum base panels to supports with steel drill screws.

G. Multilayer Fastening Methods: Fasten backing panels and gypsum-base face layers separately to supports with screws.

3.4 INSTALLING TRIM ACCESSORIES

A. General: Install trim with back flanges intended for fasteners and attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install according to ASTM C844 and in specific locations approved by Architect.

C. Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges unless otherwise indicated.

3.5 INSTALLING JOINT REINFORCEMENT

A. Gypsum Base: Reinforce interior angles and flat joints with joint tape and embedding material to comply with ASTM C843 and with gypsum veneer plaster manufacturer's written recommendations.

3.6 GYPSUM VENEER PLASTERING

A. Gypsum Veneer Plaster Mixing: Mechanically mix gypsum veneer plaster materials to comply with ASTM C843 and with gypsum veneer plaster manufacturer's written recommendations.

B. Gypsum Veneer Plaster Application: Comply with ASTM C843 and with veneer plaster manufacturer's written recommendations.

1. One-Component Gypsum Veneer Plaster: Trowel apply plaster over substrate to uniform thickness. Fill all voids and imperfections. Immediately double back with same mixer batch of plaster to a uniform total thickness of 1/16 to 3/32 inch (1.6 to 2.4 mm).

2. Where gypsum veneer plaster abuts metal, including doorframes, windows and other units, groove finish coat to eliminate spalling.
3. Do not apply veneer plaster to gypsum base if paper facing has degraded from exposure to sunlight. Before applying veneer plaster, use remedial methods to restore bonding capability to degraded paper facing according to manufacturer's written recommendations and as approved by Architect.

C. Concealed Surfaces: Do not omit gypsum veneer plaster behind cabinets, furniture, furnishings, and similar removable items. Omit veneer plaster in the following areas where it will be concealed from view in the completed Work unless otherwise indicated or required to maintain fire-resistance and STC ratings:

1. Above suspended ceilings.
2. Behind wood paneling.

D. Gypsum Veneer Plaster Finish:

1. Smooth-troweled finish unless otherwise indicated.
2. Textured finish matching existing finish and approved mockups.

3.7 PROTECTION

A. Protect installed gypsum veneer plaster from damage from weather, condensation, construction, and other causes during remainder of the construction period.

B. Remove and replace gypsum veneer plaster and gypsum base panels that are wet, moisture damaged, or mold damaged.

1. Indications that gypsum base panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
2. Indications that gypsum base panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 26 13

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.
3. Gypsum board accessories – reveals.

B. Related Requirements:

1. Section 09 22 16 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
2. Section 09 30 13 "Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum wallboard.
2. Gypsum board, Type X.
3. Gypsum ceiling board.
4. Cementitious backer units.
5. Joint treatment materials.
6. Laminating adhesive.
7. Sound-attenuation blankets.

B. Samples for Initial Selection: For each type of trim accessory indicated.

1.4 QUALITY ASSURANCE

A. Mockups: Build mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockups for the following:

a. Each level of gypsum board finish indicated for use in exposed locations.

2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Wallboard:

1. Manufacturers: Subject to compliance with requirements, undefined:

a. American Gypsum.
b. Armstrong Ceiling & Wall Solutions.
c. CertainTeed; SAINT-GOBAIN.
d. Georgia-Pacific Gypsum LLC.
e. PABCO Gypsum.
f. USG Corporation.

B. Gypsum Wallboard: ASTM C1396/C1396M.

1. Thickness: 1/2 inch (12.7 mm).
2. Long Edges: [Tapered] [Tapered and featured (rounded or beveled) for prefilling].

C. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Thickness: 5/8 inch (15.9 mm).
2. Long Edges: [Tapered] [Tapered and featured (rounded or beveled) for prefilling].

D. Gypsum Ceiling Board: ASTM C1396/C1396M.

1. Thickness: 1/2 inch (12.7 mm).
2. Long Edges: Tapered.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. C-Cure.
    b. Custom Building Products.
    c. FinPan, Inc.
    d. PermaBASE Building Products, LLC provided by National Gypsum Company.
    e. USG Corporation.

2. Thickness: 5/8 inch (15.9 mm).
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.5 GYPSUM WALLBOARD ACCESSORIES – METAL REVEALS

A. Basis of Design: Fry Reglet Drywall Reveal Molding

1. Dimensions: 1/2” wide x 5/8” deep
2. Material: Extruded aluminum
3. Finish: Field priming and painting to match scheduled wall paint color

    a. Chemical conversion coat finish: Treatment of aluminum molding shall conform with ASTM ND1730-67(1998), Type B, Standard finish

B. Basis of Design: Fry Reglet Drywall J Molding

1. Dimensions: 5/8” deep x 1-1/8” long
2. Material: Extruded Aluminum
3. Finish: Field priming and painting to match schedule wall paint color

    a. Chemical conversion coat finish: Treatment of aluminum molding shall conform with ASTM ND1730-67(1998), Type B, Standard finish.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints , rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.

    a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

D. Joint Compound for Tile Backing Panels:

1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.7 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Thermal Insulation: As specified in Section 07 21 00 "Thermal Insulation."

F. Vapor Retarder: As specified in Section 07 26 00 "Vapor Retarders."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

A. Comply with ASTM C840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
2. Fit gypsum panels around ducts, pipes, and conduits.

3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.

J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Wallboard Type: Vertical surfaces unless otherwise indicated.
2. Type X: Where required for fire-resistance-rated assembly.
3. Ceiling Type: Ceiling surfaces.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels [vertically (parallel to framing)] [horizontally (perpendicular to framing)] unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers [and face layers separately to supports with screws] [with screws; fasten face layers with adhesive and supplementary fasteners].

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 INSTALLATION OF TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A108.11, at [showers, tubs, and where indicated] [locations indicated to receive tile].

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints [, rounded or beveled edges,] and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

    a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."

E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.6 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 29 00

SECTION 09 30 00 - TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Porcelain tile.
2. Tile backing panels.
3. Metal edge strips.

B. Related Sections:

1. Section 07 92 00 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
2. Section 09 29 00 "Gypsum Board" for cementitious backer units.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."

C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

1. Level Surfaces: Minimum ≥ .60.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each type of product, signed by product manufacturer.

C. Material Test Reports: For each tile-setting and -grouting product and special purpose tile.

1.7 MAINTENANCE MATERIALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 1 unopened carton for each type, composition, color, pattern, and size indicated.
2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.8 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile of each type from one source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:

1. Joint sealants.
2. Metal edge strips.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of each type of wall tile installation.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 TILE PRODUCTS

A. Tile Type CT-1.

1. Basis of Design: Wayne Tile, Vetro Rounds, Color: Tide Blend #TIDE-BL 5262, 5/8” x 5/8” Pennyround Tile.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crossville
b. American Olean; Division of Dal-Tile International Inc.
c. Daltile; Division of Dal-Tile International Inc.
d. Florim USA.
e. Laufen.
f. Trinity Tile.

1. Composition: Glass
2. Tile Finish: Mixed
3. Pattern: As indicated on finish drawings and interior elevations.
4. Grout Color: As selected by Architect from manufacturer's full range.

2.3 SETTING MATERIALS

A. Modified Dry-Set cement mortar (Thin Set): ANSI A118.4.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C-Cure.
b. Custom Building Products.
c. Laticrete International, Inc.
d. MAPEI Corporation.
e. Mer-Kote Products, Inc.

1. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene- butadiene- rubber liquid latex additive at Project site.

2.4 GROUT MATERIALS

A. Standard Cement Grout and Standard Non-Sanded Cement Grout: ANSI A118.6.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C-Cure.
b. Custom Building Products.
c. Laticrete International, Inc.
d. MAPEI Corporation.
e. TEC; a subsidiary of H. B. Fuller Company.

B. Grout for Pregrouted Tile Sheets: Same product used in factory to pregrout tile sheets.

2.5 ELASTOMERIC SEALANTS

A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Section 079200 "Joint Sealants."

1. Use primers, backer rods, and sealant accessories recommended by sealant manufacturer.

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.

C. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; Dow Corning 786.
b. GE Silicones; a division of GE Specialty Materials; Sanitary 1700.
c. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
d. Tremco Incorporated; Tremsil 600 White.

2.6 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: L-shape, height to match tile and setting-bed thickness, metallic designed specifically wall tile trim applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.

1. Basis of Design: Schluter Systems, Profile: Jolly, finish selected from manufacturer’s full range of metal finishes.

C. Temporary Protective Coating: Either product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.

1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F (49 to 60 deg C) per ASTM D 87.
2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

E. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout.

1. Products: Subject to compliance with requirements, provide one of the following:

a. C-Cure; Penetrating Sealer 978.
b. Custom Building Products; Grout and Tile Sealer.
c. MAPEI Corporation; Ultracare Grout Sealer, Keraseal Penetrating Sealer for Unglazed Grout and Tile.
d. Southern Grouts & Mortars, Inc.; Silicone Grout Sealer.
e. TEC; a subsidiary of H. B. Fuller Company; TA-256 Penetrating Silicone Grout Sealer.

2.7 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with adhesives or thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 TILE INSTALLATION

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

E. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Porcelain Tile: 1/8 inch (3.2 mm).
2. Glazed Wall Tile: 1/16 inch (1.6mm).

F. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 TILE BACKING PANEL INSTALLATION

A. Install cementitious backer units and fiber-cement underlayment and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.5 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.6 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove epoxy and latex-portland cement grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.7 INTERIOR TILE INSTALLATION SCHEDULE

A. Interior Wall Installations, Metal Studs or Furring:

1. Tile Installation W244: Thin-set mortar on cementitious backer units; TCA W244.

a. Tile Type: CT-1
b. Thin-Set Mortar: Latex-portland cement mortar.
c. Cementitious backer unit ‘CBU’ or fiber cement underlayment
d. Grout: Standard unsanded cement grout.

END OF SECTION 09 30 00

SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for ceilings.

B. Perimeter Trim.

C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.

C. Samples for Initial Selection: For components with factory-applied color finishes.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of full-size 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.
2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- (150-mm-) long Samples of each type, finish, and color.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which suspension systems will be attached.
3. Size and location of initial access modules for acoustical panels.
4. Items penetrating finished ceiling including the following:

   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.

5. Perimeter moldings.

B. Product Test Reports: For each acoustical panel ceiling, for tests performed by a qualified testing agency.

C. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

1.6 WARRANTY

A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:

1. Acoustical Panels: Sagging and warping
2. Grid System: Rusting and manufacturer's defects

B. Warranty Period:

1. Acoustical panels: Ten (10) years from date of substantial completion.
2. Grid: Ten (10) years from date of substantial completion.

1.7 MAINTENANCE MATERIAL

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Panel Ceilings: Full-size units equal to 10% of amount installed for each type indicated, but not less than 1 unopened carton.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
2. Smoke-Developed Index: 450 or less.

2.2 ACOUSTICAL PANELS, GENERAL

A. Source Limitations:

1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
2. Suspension System: Obtain each type from single source from single manufacturer.

B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.

C. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.

D. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface according to ASTM E 795.

E. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 ACOUSTICAL PANELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong World Industries, Inc.
2. CertainTeed Corp.
3. USG Interiors, Inc.; Subsidiary of USG Corporation.

B. Acoustical Panel – ACT-1 (General Ceiling Tile)

1. Manufacturer: Armstrong World Industries, Inc.
2. Type: Ultima High NRC #1940.

a. Type A, Form A2.2, Pattern E

3. Performance Characteristics:

a. Sound Control: Noise Reduction Coeffecient: NRC of .80 in compliance with ASTM X 423.
b. CAC: 35.
c. Light Reflectance: 0.85.

4. Surface Burning:

a. Class A, per ASTM E 1264.

5. Light Resistance: Actual light reflectance shall be .87 according to ASTM E 1477.
6. Product Characteristics:

a. Size: 24-inch by 24-inch by 7/8-inch
b. Edge Detail: Square Lay-In edge panels for general ceilings & ceiling clouds
c. Substrate: Wet Formed Mineral Fiber with DuraBrite.
d. Surface: DuraBrite with factory applied latex paint.
e. Suspension System: Prelude 15/16-inch Exposed Tee grid systems.

7. Recycled Content: Up to 87%.

C. Acoustical Panel – ACT-2 (Seminar/ Boardroom)

1. Manufacturer: Armstrong World Industries, Inc.
2. Type: Ultima High NRC #2081.

    a. Type A, Form A2.2, Pattern E

3. Performance Characteristics:
    a. Sound Control: Noise Reduction Coeffecient: NRC of .85 in compliance with ASTM X 423.
    b. CAC: 35.
    c. Light Reflectance: 0.85.

4. Surface Burning:

    a. Class A, per ASTM E 1264.

5. Light Resistance: Actual light reflectance shall be .87 according to ASTM E 1477.
6. Product Characteristics:

    a. Size: 24-inch by 24-inch by 7/8-inch
    b. Edge Detail: Tegular edge panels for ceiling clouds
    c. Substrate: Wet Formed Mineral Fiber with DuraBrite.
    d. Surface: DuraBrite with factory applied latex paint.
    e. Suspension System: Prelude 15/16-inch Tegular Tee grid systems.

7. Recycled Content: Up to 87%.
8. All tegular tiles located at edges of Axiom Trim cloud, cut edges to be recreated.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.

B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

    a. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
    b. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
    c. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.

C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.

D. Hanger Rods Mild steel, zinc coated or protected with rust-inhibitive paint.

E. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.

2.5 METAL SUSPENSION SYSTEM

A. Basis-of-Design Product: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong World Industries, Inc.
2. CertainTeed Corp.
3. USG Interiors, Inc.; Subsidiary of USG Corporation.

B. Double-Web,Hot-Dip Galvanized, G60 (Z180), Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; hot-dip galvanized according to ASTM A 653/A 653M, G60 (Z180) coating designation; with prefinished, cold-rolled, 9/16-inch- (18-mm-) wide aluminum caps on flanges.

1. Structural Classification: Intermediate-duty system.
2. Face Design: Flat, flush.
3. Face Finish: Painted white.

C. Wide-Face, Capped, Double-Web,Hot-Dip Galvanized, G60 (Z180), Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; hot-dip galvanized according to ASTM A 653/A 653M, G60 (Z180) coating designation; with prefinished, cold-rolled, 15/16-inch- (24-mm-) wide aluminum caps on flanges.

1. Structural Classification: Intermediate-duty system.
2. Face Design: Flat, flush.
3. Face Finish: Painted white.

2.6 METAL SUSPENSION SYSTEMS FOR CLOUDS

A. Components: Main beams and cross tees, base metal and end detail, fabricated from commercial quality hot dipped galvanized steel complying with ASTM A 653. Main beams and cross tees are double-web steel construction with exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.

1. Structural Classification: ASTM C 635 Intermediate Duty
2. Color: White and match the actual color of the selected ceiling tile, unless noted otherwise.
3. Acceptable Product: Suprafine XL 9/16" Exposed Tee as manufactured by Armstrong World Industries, or equal.

B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

C. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least time three design load, but not less than 12 gauge.

D. Edge Moldings and Trim:

1. 7800 Wall Molding

2.7 ALUMINUM PERIMETER TRIM – EXTRUDED FOR CLOUDS

A. Product/Manufacturer: Axiom Classic Armstrong World Industries, Incorporated

1. Commercial quality extruded aluminum alloy 6063 trim channel, factory finished in baked polyester paint.
2. Commercial quality galvanized steel unfinished T-bar connection clips; galvanized steel splice plates.

   a. Color: White. Match actual color of the selected ceiling tile, unless noted otherwise
   b. Size: 2in high x custom lengths, refer to architectural drawings.
   c. Acceptable Product: Axiom Classic, AX2STR, as manufactured by Armstrong World Industries, or equal.

B. Axiom Trim Channel: 2in Axiom Classic.

C. Axiom Outside Corner Posts (Straight Only): 2in Axiom Classic Outside Corner Post

D. Critical Installation Accessories:

1. AXSPLICE - Splice with set screws, galvanized steel, unfinished, used to attached factory-mitered inside corners
2. AX2HGC – Hanging Clip, Steel formed to fit into special trim channel bosses. Provide positive mechanical lock and screw-fastened connection to suspension members that intersect below the trim channel
3. AXTBC - T-bar Connector Clip, galvanized steel, unfinished, used to attach channel trim to supporting suspension members.

2.9 METAL EDGE MOLDINGS AND TRIM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong World Industries, Inc.
2. CertainTeed Corp.
3. Fry Reglet Corporation.
4. Gordon, Inc.
5. USG Interiors, Inc.; Subsidiary of USG Corporation.

B. Extruded aluminum trim: Manufacturer’s standard moldings for edges and penetrations; formed from aluminum for curved wall molding.

C. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated
2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.

PART 2 - EXECUTION

2.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

2.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

2.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures. Cloud hangers shall attach to grid above or provide pin-hole through upper ceiling to attach to structure.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post installed anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
2. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned acoustical panels as follows:

   a. As indicated on reflected ceiling plans.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
6. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions unless otherwise indicated.

2.4 FIELD QUALITY CONTROL

A. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports.

2.5 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 13

SECTION 09 54 00 – INTEGRATED CEILING ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Acoustical ceiling panel
2. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings
3. Perimeter Trim
4. Access Panels

B. Related Sections:

1. Section 09 51 13 – Acoustical Fabric-Faced Panel Ceilings
2. Section 09 22 16 – Non-Structural Metal Framing

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
4. ASTM C 645 Standard Specification for Metal Suspension Systems
5. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels
6. ASTM C754 AND C1858 All installations should be in compliance with these tests.
7. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
8. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
9. ASTM E 1264 Classification for Acoustical Ceiling Products
10. ASTM E3090 All references to suspension component property testing per this test method.

B. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures

1.4 SYSTEM DESCRIPTION

A. Continuous/Wall-to-Wall

1.5 SUBMITTALS

A. Shop Drawings: Layout and details of ceilings. Show locations of items that are to be coordinated with, or supported by the ceilings.

B. Installation Instructions: Submit manufacturer's installation instructions as referenced in Part three, Installation.

C. Product Data: Submit manufacturer's technical data for each type of ceiling unit, suspension system and access panel required.

D. Samples: Minimum 6 x 6 inch samples of specified panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.

E. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.

1.6 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.

B. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.

C. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 Classification.

D. Acoustical Panels: As with other architectural features located at the ceiling that may obstruct or skew the planned fire sprinkler pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.

E. Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers. Panels are 7/8" thick.

F. Installer Qualification: Subcontractor is an experienced Installer that has reviewed and understands the system installation instructions thoroughly. Subcontractor will follow written installation instructions and utilize approved equipment and procedures for finishing installation.

G. Panels are to be finished to a level 4 drywall finish equivalent. Installing panel system requires special attention to finishing details. Light coves and low angle lighting will exaggerate imperfections.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages/crates and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content. Store all material within temperature limits required by manufacturer.

C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

1.8 PROJECT CONDITIONS

A. Space Enclosure:

1. Building areas to receive ceilings shall be free of construction dust and debris. Panels should be installed in areas where the building is enclosed and the HVAC is continuously functioning. This product is not recommended for exterior applications, where standing water is present, or where moisture will come into direct contact with the ceiling.

a. HVAC should be designed, installed, and operated in accordance with ASHRAE Standard 62.1. It is also necessary for the area to be enclosed, for the HVAC systems to be functioning, and in continuous operations for the life of the product. Product is not intended for use where natural ventilation is part of the ventilation strategy and not recommended in areas where a differential plenum pressure exists.

1.9 WARRANTY

1. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:

    a. Acoustical Panels: Manufacturer’s defects in material.
    b. Grid System: Rusting and manufacturer's defects.
    c. Access Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period.

2. Warranty Period:

    a. Acoustical panels: Ten (10) years from date of substantial completion.
    b. Suspension: Ten (10) years from date of substantial completion.
    c. Architectural Forms: One (1) year from date of substantial completion.

3. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design AcoustiBuilt Seamless Acoustical Ceiling System by Armstrong World Industries, or approved equal.

B. Finish

1. Joint Compound Finish by Others
2. Spray Applied Finish by manufacturer.

C. Suspension Systems: manufacturer’s standard

D. Perimeter Trim Systems: manufacturer’s standard

E. Soffit Construction: manufacturer’s standard

2.2 ACOUSTICAL CEILING UNITS

A. Acoustical Panels

1. Surface Texture: Fine
2. Composition: Mineral Fiber
3. Color:

    a. White (Fine Texture Finish for AcoustiBuilt panels)

4. Size: 48 in x 72 in x 7/8 in - Item #2604
5. Edge Profile: Tapered edges four sides
6. Noise Reduction Coefficient (NRC): ASTM C 423; Panel 0.80 (UL)
7. Ceiling Attenuation Class (CAC): ASTM C 1414; Panel 46 (UL), System up to 48
8. Sabin: Cloud Applications: 0.80 Sabins/SF & 1.33 Sabins/SF with infill item 8200T10
9. Flame Spread: ASTM E 1264; Class A
10. Light Reflectance (LR) White Panel: ASTM E 1477; 0.87
11. Dimensional Stability: HumiGuard Plus
12. Basis-of-Design Product: AcoustiBuilt panels #2604 No added formaldehyde, as manufactured by Armstrong World Industries, or approved equal.

B. Finish

1. Joint Compound

   a. Setting Compound: Lightweight setting-type drywall joint compound, Ultra lightweight drying-type drywall joint compound
   b. Joint Tape: Self-Adhesive mesh drywall joint tape (Panel to Panel)

      1) Use Setting Type Compound for initial coats and use Drying Type Compound for final coats per the installation instructions. DO NOT use any other type of drywall compound such as All-Purpose Compound.
      2) Paper tape at the wall intersection.

2. Spray Applied Finish – Required Product: #2605WH or 2605BL Fine Texture Finish for panels – White, by manufacturer.

C. Suspension Systems

1. Manufacturer's Drywall Suspension Systems all main beams and cross tees shall be commercial quality hot-dipped galvanized steel.

   a. Main beam: manufactured main beam- 1-1/2" knurled face with ScrewStop™ reverse hem by 1-11/16 inches high. Drywall Main Beams are factory punched with cross tee routs, hanger wire holes, and main beam clip for a strong secure connection and fast accurate alignment. Drywall Main Beams are Heavy-duty performance per ASTM C635.
   b. Basis-of-Design: HD8906 - 12ft HD Drywall Main Beam 1-1/2 in.

2. Cross Tees: manufactured cross tee- 1-1/2" knurled face with reverse hem by 1-1/2 inches high with factory punched cross tee routs and hanger wire holes and XL stake on clip for a strong secure connection.

   a. Basis-of-Design: XL8945P - 4ft Drywall Cross Tee

3. Wall Molding:

   a. Basis-of-Design: KAM12 - 12ft Knurled Angle Molding 1-1/4" Face

4. Hanger wire: a Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least time three times the design load, but not less than 12-gauge.
5. Fasteners (for Panel attachment)

   a. #6 x 1-5/8" Fine thread drywall screws
   b. Adhesives, as recommended by manufacturer.

6. Perimeter Systems

   a. Commercial quality extruded aluminum alloy 6063 trim channel, factory finished in baked polyester paint. Commercial quality galvanized steel unfinished T-bar connection clips; galvanized steel splice plates.

      1) Color: White
      2) Size: 120 in X 4 in (also available in 6")
      3) Basis-of-Design: AXIOM One Piece for Drywall, 4in Straight – AX1PC4STR or Curved AX1PC4CUR as manufactured by Armstrong World Industries

   b. Axim Trim Channel:

      1) Basis-of-Design: AX4STR 4in Axiom Classic Straight
      2) Basis-of-Design: AX1PC4STR 4IN One –Piece Drywall Trim

c. Bottom Trim with taping flange

1) Basis-of-Design: AXBTASTR – Bottom Trim for AcoustiBuilt (also available in curved)

d. Accessories:

1) Basis-of-Design: AXSPLICE - Splice Plate

D. Basis-of-Design: CastWorks Access panels for AcoustiBuilt

1. Surface Texture: Standard unfinished, paint grade. Can be coated to achieve any desired color.
2. Composition: Glass Fiber Reinforced Gypsum (GFRG/GRG)
3. Colors: Paint Grade (CPG)
4. Door Type: Lay-in
5. Door Shape: Squared Corners, Rounded Corners
6. Door Size: 9 in x 9 in, 12 in x 12 in, 16 in x 16 in, 18 in x 18 in, 24 in x 24 in, 22 in x 30 in (gasketed), 30 in x 30 in, 30 in x 30 in (gasketed)
7. Frame Thickness: 7/8 in (for AcoustiBuilt panels)
8. Design:

a. Squared Corners Lay-in 7/8" frame thickness:
AS0300S02T7G0CPG, AS0300S04T7G0CPG, AS0300S05T7G0CPG
b. Rounded Corners Lay-in 7/8" frame thickness:
AS0300R02T7G0CPG, AS0300R04T7G0CPG, AS0300R05T7G0CPG

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before installation, inspect previous work of all other trades. Verify that all work is complete and accurate to the point where this installation may properly proceed in strict accordance with framing shop drawings.

B. If framing preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. The system installation is similar to a conventional drywall installation. However, there are key differences in both material substrate and methods of finishing and installation that make this system unique.

D. Installation: In accordance with all approved plans, details, and manufacturer's installation guidelines.

1. Install seismic components if required by the building code. Seismic components to be specified on the architectural plans by the project engineer or design team.
2. Suspend main beam from overhead construction with hanger wires spaced 4-0 ft. on center along the length of the main runner. Install hanger wires plumb and straight.
3. 48” Cross tees shall be installed 16” on center. Extra cross tees are required at 72” every 12’. All 4 panel edges must be supported by a grid main or tee.
4. Install wall moldings/perimeter trim at intersection of suspended ceiling and vertical surfaces
5. Main runners and cross tees shall be attached at perimeter conditions
6. When determining the grid layout, consider the long edges of the boards must run parallel with the mains.
7. This system relies on a square grid system to ensure panel edges align at centers of cross tees. If the installation does not meet these squareness requirements, the panel edges may run off the grid system.

a. The system must be square to within 1/8" over a 48" x 48" module.
b. The suspension system must be leveled to within 1/4" in 10.

8. Floating perimeters must be trimmed with either One-Piece Drywall Trim or with Bottom Trim. Refer to the installation instructions for integration with installations.
9. Install access doors where plenum access is required.

3.2 PREPARATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations.

B. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.

C. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

3.3 INSTALLATION

A. Control joints are required following the standards used for gypsum board listed in ASTM C840, Section 20.

1. Ceilings with perimeter relief cannot exceed 50 LF and 2500 SF between control joints
2. Ceilings without perimeter relief cannot exceed 30 LF and 900 SF between control joints

B. Panel joints and fasteners are finished with tape and compound to create a flat surface. While the materials used to finish panels are also used to finish drywall, the procedure has unique requirements.

C. Joint compound coverage shall be limited to preserve the acoustical performance of the panels. Compound at panel joints shall not exceed 8 inch widths. Compound applied to field fasteners shall not exceed 2 inch by 2-inch areas. All compound shall be smooth and free of tool marks and ridges. Panels are to be finished with taping knives. Production tools, including boxes, are detailed on the installation instructions.

D. Sanding and inspection: Throughout the sanding process, inspect the surface frequently for flatness. Direct a light across the ceiling to highlight unevenness that requires attention.

E. Fine Texture Finish shall be applied in 4-5 coat process (additional coat may be used to achieve the desired finish) as called out in the installation instructions. Fine Texture Finish for AcoustiBuilt is applied in multiple coats, layered to achieve a uniform appearance and acoustical performance. It is strongly encouraged to practice spraying to ensure proper calibration and technique are achieved. Refer to the installation video.

1. Fine texture finish MUST be sprayed with a Graco Mark V texture system, or equal. This equipment properly atomizes the finish for acoustics and aesthetics. Fine texture finish is not intended for use with any other airless paint systems not recommended by manufacturer or to be applied by brush or rolling.
2. See Manufactures installation instructions for correct spray tip, pressure settings for spray system, finish preparation, spray calibration and spray procedure and technique.

3.4 ADJUSTING AND CLEANING

A. To remove soot, dirt, and dust use a vacuum operating at low power with a soft brush or use a dry soot cleaning sponge.

B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage.

END OF SECTION 09 54 00

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Resilient base.

B. Related Sections:

1. Section 09 65 19 "Resilient Tile Flooring" for resilient floor tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of product indicated.

C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

D. Product Schedule: For resilient products.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Mockups: Provide resilient products with mockups specified in other Sections.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.7 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

A. Resilient Base: Basis-of-Design: Johnsonite rubber wall base.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
b. Endura Rubber Flooring; Division of Burke Industries, Inc.
c. Flexco, Inc.
d. Tarkett.
e. Mondo Rubber International, Inc.
f. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
g. Roppe Corporation, USA.

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TP (rubber, thermoplastic).
2. Manufacturing Method: Group I (solid, homogeneous).
3. Style: Tightlock Wall Base System for carpet & tile.

C. Minimum Thickness: 0.125 inch (3.2 mm).

D. Height: 4 inches (102 mm).

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Preformed.

G. Inside Corners: Job formed or preformed.

H. Finish: Matte.

I. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)
2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:

1. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products until Substantial Completion.

END OF SECTION 09 65 13

SECTION 09 65 19 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Luxury vinyl tile.
2. Stainless steel transition accessories.

B. Related Sections:

1. Division 09 Section "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

C. Samples for Initial Selection: For each type of floor tile indicated.

D. Samples for Verification: Full-size units of each color and pattern of floor tile required.

E. Product Schedule: For floor tile.

F. Qualification Data: For qualified Installer.

G. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.

B. ASTM F2170 Standard test method for determining relative humidity in concrete floor slabs.

C. ASTM D2047 Standard test method for static coefficient of friction.

E. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

C. Pre-installation Conference: Conduct conference at Project site 2 weeks prior to start of work.

1. Review methods and procedures related to Resilient Tile Flooring including, but not limited to, the following:

    a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
    b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    c. Review designs and patterns.
    d. Review dust-control procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.6 WARRANTY

A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of. Other rights Owner may have under Contract Documents.

Warranty Period: Fifteen (15) years commencing on date of substantial completion.

1.7 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 80 deg F (29 deg C), in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish 1 unopened box of each type, color, and pattern of floor tile installed.

PART 2 - PRODUCTS

2.1 LUXURY VINYL TILE: LVT-1

A. Basis-of-Design: Subject to compliance with requirements, provide Interface Ridge #A023 or equal.

B. Tile Standard: ASTM F 1700, Class 3, printed vinyl tile.

C. Wearing Surface: Smooth, 22mil wear layer.

D. Thickness: 0.177 inch (4.5 mm).

E. Size: 50cm by 50cm.

F. Colors: As Indicated on Finish plans and schedule.

G. Patterns: As indicated on finish drawings.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. VCT Adhesives: Not more than 50 g/L.

C. Metal Transitions
1. Basis-of Design: Schluter stainless steel transition for floors; Profile: RENO.
a. Type and dimensions to be determined by flooring transition conditions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.

a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are same temperature as space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

C. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

E. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

F. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products until Substantial Completion.

END OF SECTION 09 65 19

SECTION 09 68 13 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes
1. Modular, Carpet Tile.
2. Area Rug, Carpet Tile.
3. Stair Runner, Broadloom Carpet

B. Related Requirements:

1. Division 09 Section "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site 2 weeks prior to start of work.

1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:

a. Review delivery, storage, and handling procedures.
b. Review ambient conditions and ventilation procedures.
c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include installation recommendations for each type of substrate.

B. Shop Drawings: Show the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Type, color, and location of insets and borders.
7. Type, color, and location of edge, transition, and other accessory strips.
8. Transition details to other flooring materials.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.

D. Product Schedule: For all carpet. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.7 MAINTENANCE MATERIAL

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Provide one unopened carton for each type indicated.

1.8 QUALITY ASSURANCE

A. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockups at locations and in sizes shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

1.10 FIELD CONDITIONS

A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.11 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, excessive surface wear, edge ravel, backing separation, shrinking, stretching and static electricity. Excessive surface wear means loss of more than 10% by weight of face fiber.
3. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE: CP-1

A. Products: Subject to compliance with requirements, provide the following:

1. Interface, Step Repeat Collection Walk-Off Carpet Tile, Pattern: SR899

B. Color: As indicated on finish plans and schedules.
C. Fiber Content: 100% Recycled Content Nylon
D. Pile Characteristic: Tufted Textured Loop.
E. Pile Hieght: 5.1 mm.
F. Pile Thickness: 3.6 mm
G. Primary Backing/Backcoating: GlasBac.
H. Size: 50 cm X 50 cm modules.

2.2 CARPET TILE: CP-2

A. Products: Subject to compliance with requirements, provide the following:

1. Interface, Third Space 309 #1681102500

B. Colors: As indicated on finish plans and schedules.
C. Fiber Content: 100% Solution Dyed Polyester – Universal Fibers.
D. Pile Characteristic: Tufted Textured Loop.
E. Tufted Yarn Weight: 22 oz/syd.
F. Pile Thickness: 0.112 inches
G. Primary Backing/Backcoating: GlasBac.
H. Size: 50 cm x 50 cm modules.

2.3 CARPET TILE: CP-3

A. Products: Subject to compliance with requirements, provide the following:

1. Tarkett, Knitstitch #1406002500 custom colored carpet tile.

B. Color: As indicated on finish plans and schedules.
C. Fiber Content: 100% Solution Dyed Polyester – Universal Fibers.
D. Stitches per Inch: 10 per inch.
E. Tufted Yarn Weight: 17 oz/syd.
F. Pile Thickness: 0.112 inches.
G. Primary Backing/Backcoating GlasBac.
H. Size: 50 cm x 50cm modules.

2.4 CARPET TILE: CP-4

A. Products: Subject to compliance with requirements, provide the following:

1. Interface, Reflective Sky #140960AK00.

B. Colors: As indicated on finish plans and schedules.
C. Fiber Content: 100% Solution Dyed Polyester – Universal Fibers.
D. Stitches per Inch: 7.1 per inch.

E. Tufted Yarn Weight: 25 oz/syd.
F. Pile Thickness: 0.097 inches.
G. Primary Backing/Backcoating: GlasBac.
H. Size: 25 cm x 1m modules.

2.5 CARPET TILE: CP-5

A. Products: Subject to compliance with requirements, provide the following:
   1. Bentley, Hamitsu San #6AHS20AA1K.

B. Color: As indicated on finish plans and schedules.
C. Fiber Content: 100% Solution Dyed Polyester – Universal Fibers.
D. Pile Characteristic: Tufted Textured Loop.
E. Tufted Yarn Weight: 20 oz/syd.
F. Pile Thickness: 0.24 inches.
G. Primary Backing/Backcoating: GlasBac.
H. Size: 18 x 36 inch modules.

2.6 CARPET TILE: CP-6 – Custom Area Rug

A. Products: Subject to compliance with requirements, provide the following:

   1. Shaw Contract, Metal Edge Tile #5T620

B. Color: As indicated on finish plans and schedules.
C. Fiber Content: 100% Solution Dyed EcoSolution Q100 Nylon.
D. Pile Characteristic: Multi-Level Pattern Cut/ Loop.
E. Tufted Yarn Weight: 26 oz/syd.
F. Pile Thickness: 0.292 inches.
I. Primary Backing/Backcoating: Synthetic, EcoWorx.
K. Size: 24 x 24 inch modules.
L. Carpet Tile to be configured, all one piece, ashlar configuration, non-skid backing with serged/ finished edge.

2.7 CARPET TILE: CP-7 – Stair Runner

A. Products: Subject to compliance with requirements, provide the following:

   1. Shaw Contract, Chok Loom Broadloom #5A211

B. Color: As indicated on finish plans and schedules.
C. Fiber Content: EcoSolution Q Nylon.
D. Pile Characteristic: Multi-Level Pattern Cut/ Loop.
E. Tufted Yarn Weight: 38 oz/syd.
F. Pile Thickness: 0.345 inches.
G. Primary Backing/Backcoating: Synthetic, Ultraloc
H. Custom sized, non-skid backing, serged/ finished edges.
I. Coordinate with manufacturer for all installation methods and materials.

2.5 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

A. Adhesives: Water-resistant, mildew-resistant, non-staining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

D. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: Glue down; install every tile with full-spread, releasable or pressure-sensitive installation system.

C. Maintain dye lot integrity. Do not mix dye lots in same area.

D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

G. Install pattern parallel to walls and borders.

H. Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 68 13

SECTION 09 72 00 - WALL COVERINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vinyl wall covering.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.

B. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement, seams and termination points.

C. Samples: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36 inches (914 mm) long in size.

1. Wall-Covering Sample: From same production run to be used for the Work, with specified treatments applied.

a. Show complete pattern repeat.
b. Mark top and face of fabric.

D. Samples for Initial Selection: For each type of wall covering.

E. Samples for Verification: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36 inches (914 mm) long in size.

1. Wall-Covering Sample: From same production run to be used for the Work, with specified treatments applied.

a. Show complete pattern repeat.
b. Mark top and face of fabric.

F. Product Schedule: For wall coverings. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Wall-Covering Materials: For each type, color, texture, and finish, full width by length to equal to 5 percent of amount installed.

1.8 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for installation.

1. Build mockups for each type of wall covering on each substrate required. Comply with requirements in ASTM F1141 for appearance shading characteristics.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.

1. Wood-Veneer Wall Coverings: Condition spaces for not less than 48 hours before installation.

B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.

C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates in accordance with test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

2. Fire-Growth Contribution: No flashover and heat and smoke release when tested in accordance with NFPA 265.

2.2 VINYL WALL COVERING, WC-1

A. Description: Provide vinyl products in rolls from same production run and complying with the following:

1. Wallcovering Association's W-101 for Type II, Medium Duty.

a. Category: V, Type II, Commercial Serviceability (Vinyl Coated).

B. Basis-of-Design: Maharam Perch.

C. Total Weight: 20 oz/ly excluding coatings.

D. Width: 54 inches (1372 mm).

E. Backing: Cotton Osanaburg/Polyester fabric.

1. Fiber Content: Cotton and Polyester.

F. Mildew Resistance: Rating of zero or 1 when tested in accordance with ASTM G21.

G. Features:

1. Stain-Resistant Coating.
2. PFAS free.

H. Colors, Textures, and Patterns: As selected by Architect from manufacturer's full range, refer to Drawings.

2.3 ACCESSORIES

A. Adhesive: Mildew-resistant, nonstaining adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.

B. Primer/Sealer: Mildew resistant, complying with requirements in Section 09 91 23 "Interior Painting" and recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.

C. Seam Tape: As recommended in writing by wall-covering manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation surfaces being true in plane and vertical and horizontal alignment, maximum moisture content, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, and mildew.

C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.

1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
2. Plaster: Allow plaster to cure for at least 90 days. Neutralize areas of high alkalinity. Apply primer/sealer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
3. Metals: If not factory primed, clean and apply metal primer as recommended in writing by metal-primer manufacturer and wall-covering manufacturer.
4. Gypsum Board: Apply primer/sealer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
5. Painted Surfaces:

a. Check for pigment bleeding. Apply primer/sealer to areas susceptible to pigment bleeding as recommended in writing by primer/sealer manufacturer.
b. Sand gloss, semigloss, and eggshell finishes with fine sandpaper.

D. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

E. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 INSTALLATION OF WALL LINER

A. Install wall liner, without gaps or overlaps. Form smooth wrinkle-free surface for finished installation. Do not begin wall-covering installation until wall liner has dried.

3.4 INSTALLATION OF WALL COVERING

A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.

B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.

C. Install strips in same order as cut from roll.

1. For solid-color, even-texture, or random-match wall coverings, reverse every other strip.

D. Install wall covering without lifted or curling edges and without visible shrinkage.

E. Install seams vertical and plumb at least 6 inches (152 mm) from outside corners and 6 inches (152 mm) from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.

F. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.

G. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

3.5 CLEANING

A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.

B. Use cleaning methods recommended in writing by wall-covering manufacturer.

C. Replace strips that cannot be cleaned.

D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 09 72 00

SECTION 09 84 33 - SOUND-ABSORBING WALL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes shop-fabricated, wood-diffuser panel units tested for acoustical performance, including:

1. Sound-absorbing wall panels.

1.3 REFERENCES

A. ASTM International:

1. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

1.4 DEFINITIONS

A. NRC: Noise Reduction Coefficient.

B. SAA: Sound Absorption Average.

1.5 SUBMITTALS

A. Product Data: For each type of panel and mounting indicated.

B. Shop Drawings: For sound-absorbing wall units. Include mounting devices and details; details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections.

1. Include elevations showing panel sizes and direction of fabric weave and pattern matching.

C. Samples for Verification: For the following products, prepared on Samples of size indicated below:

1. Core Material: 12-inch- (300-mm-) square Sample at corner.
2. Panels: Approximately 8 by 4 inches.

D. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Electrical outlets, switches, and thermostats.
2. Items penetrating or covered by sound-diffusing wall units including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Alarms.
e. Sprinklers.
f. Access panels.

E. Product Certificates: For each type of sound-diffusing wall unit, from manufacturer.

F. Maintenance Data: For sound-diffusing wall units to include in maintenance manuals.

G. Warranty: Sample of special warranty.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain sound- diffusing wall units from single source from single manufacturer.

B. Fire-Test-Response Characteristics: Provide sound- diffusing wall units meeting the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: As determined by testing per ASTM E 84.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Meeting acceptance criteria of local code and authorities having jurisdiction when tested according to [NFPA 265] [NFPA 286].

C. Pre-installation Conference: Conduct conference at Project site prior to installation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install sound- diffusing wall units until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use. Temperature range shall be between 60-80 °F and 45% relative humidity.

B. Lighting: Do not install sound- absorbing wall units until a permanent level of lighting or a lighting level of not less than 50 fc (538 lux) is provided on surfaces to receive the units.

C. Air-Quality Limitations: Protect sound- absorbing wall units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.

D. Field Measurements: Verify locations of sound- absorbing wall units and actual dimensions of openings and penetrations by field measurements before fabrication.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sound- diffusing wall units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to the following:

a. Acoustical performance.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOUND- ABSORBING WALL UNITS (AWP)

A. Basis-of-Design Product: Subject to compliance with requirements, provide Decoustics Acoustical Wall Panels MBI Colorsonix custom panels.

1. Acoustical Panel Systems (APS, Inc.).
2. Armstrong World Industries.
3. Conwed Designscape; an Owens Corning company.
4. Golterman & Sabo.
5. RPG
6. Wall Technology, Inc.; an Owens Corning company.
7. AVL Acoustech.
8. ESSI Acoustical Products Co.

B. General Requirements for Sound-Absorbing Wall Units: Provide sound-absorbing wall panels that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including 2004 Addenda.

C. Wall Panels:

1. Thickness: 1 inch.
2. Size: As indicated on drawings.
3. Core: 6 lb/c.f. – 7 lb/c.f. density semi-rigid, fiberglass, acoustically absorptive core.
4. Acoustics: Minimum NRC Rating of 0.85
5. Mounting Accessories: per manufacturer’s recommendations for intended application
6. Edges: Square edge, Chemically hardened.
7. Finish: DesignTex Pattern: Blur as selected from full manufacturer’s range.

    a. Content: Polyester
    b. Width: 54 inches (137 cm)

2.2 FABRICATION

A. General: Use manufacturer's standard construction except as otherwise indicated.

B. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch (1.6 mm) for the following:

1. Thickness.
2. Edge straightness.
3. Overall length and width.
4. Squareness from corner to corner.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fabricated units, substrates, areas, and conditions, for compliance with requirements, installation tolerances, and other conditions affecting performance of sound-diffusing wall units.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sound-absorbing wall units in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

B. Comply with sound-absorbing wall unit manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

3.3 INSTALLATION TOLERANCES

A. Variation from Plumb and Level: Plus or minus 1/16 inch (1.6 mm).

B. Variation of Panel Joints from Hairline: Not more than 1/16 inch (1.6 mm) wide.

3.4 CLEANING

A. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 09 84 33

SECTION 09 91 13 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following new exterior substrates:

1. Steel.
2. Wood.

B. Related Sections include the following:

1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
2. Division 09 Section "Interior Painting" for surface preparation and the application of paint systems on interior substrates.
3. Division 09 Section “Maintenance Repainting” for surface preparation and the application of paint systems to existing materials.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY CONTROL

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Professional will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Professional will designate items or areas required.

2. Final approval of color selections will be based on benchmark samples.

a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Professional at no added cost to the Agency.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.7 MAINTENANCE MATERIAL

A. Furnish extra materials from same product run that match products installed in unopened cans and identified with labels describing color and paint type.

1. Exterior Paint: Provide one gallon for each color and paint type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS - PAINT

A. Manufacturers: Basis-of-Design: Sherwin-Williams Company or subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore & Co.
2. Duron, Inc.
3. PPG Architectural Finishes, Inc.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors: As selected by Professional from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Wood: 15 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

E. Wood Substrates:

1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.

2. Sand surfaces that will be exposed to view and remove sanding dust.

3. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Professional, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Steel Substrates:

1. Alkyd System:

a. Prime Coat: Epoxy anticorrosive metal primer. MPI #101
b. Intermediate Coat: High-build epoxy, MPI #108, SW Macropoxy 646 Fast Cure Epoxy.
c. Topcoat: Two-component pigmented polyurethane gloss Level 6, MPI #72, SW Acrolon 218 HS.

E. Wood / Dressed Lumber Substrates (Windows):

1. Latex System:

a. Prime Coat: Exterior latex matching topcoat. MPI #6, SW Multi Purpose Latex Primer.
b. Intermediate Coat: Exterior latex matching topcoat.
c. Topcoat: Exterior latex semi-gloss (Gloss Level 5). MPI #11, SW Solo Interior/Exterior 100% Acrylic Semi-Gloss.

END OF SECTION 09 91 13

SECTION 09 91 23 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes surface preparation and application of paint systems to new interior substrates and existing substrates receiving complete new coating systems, except existing painted substrates designated for maintenance repainting.

1. Wood.
2. Steel.
3. Gypsum board.
4. Plaster.

B. Related Sections include the following:

1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
2. Division 06 Sections for shop priming carpentry with primers specified in this Section.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY CONTROL

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.7 MAINTENANCE MATERIAL

A. Furnish extra materials from same product run that match products installed in unopened cans and identified with labels describing color and paint type.

1. Interior Paint: Provide one gallon for each color and paint type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Paint and Coatings Manufacturers: Basis-of-Design: Sherwin-Williams Company or subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore & Co.
2. Duron, Inc.
3. M.A.B. Paints
4. PPG Architectural Finishes, Inc.

2.2 PAINT & COATINGS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Chemical Components of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions; these requirements do not apply to primers or finishes that are applied in a fabrication or finishing shop:

1. Flat Paints and Coatings: VOC content of not more than 50 g/L.
2. Nonflat Paints and Coatings: VOC content of not more than 150 g/L.
3. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
4. Restricted Components: Paints and coatings shall not contain any of the following:

a. Acrolein.
b. Acrylonitrile.
c. Antimony.
d. Benzene.
e. Butyl benzyl phthalate.
f. Cadmium.
g. Di (2-ethylhexyl) phthalate.
h. Di-n-butyl phthalate.
i. Di-n-octyl phthalate.

j. 1,2-dichlorobenzene.
k. Diethyl phthalate.
l. Dimethyl phthalate.
m. Ethylbenzene.
n. Formaldehyde.
o. Hexavalent chromium.
p. Isophorone.
q. Lead.
r. Mercury.
s. Methyl ethyl ketone.
t. Methyl isobutyl ketone.
u. Methylene chloride.
v. Naphthalene.
w. Toluene (methylbenzene).
x. 1,1,1-trichloroethane.
y. Vinyl chloride.

C. Colors: As selected by Professional from manufacturer's full range.

2.3 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.

B. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated: MPI #36.

C. Bonding Primer: MPI #17.

2.4 METAL PRIMERS

A. Rust-Inhibitive Primer (Water Based): MPI #107.

B. Interior and exterior Bonding Primer: MPI #17.

C. Primer, alkyd, quick-dry, for metal: MPI #76.

2.5 WOOD PRIMERS

A. Interior Latex-Based Wood Primer: MPI #39.

2.6 ACRYLIC LATEX PAINTS

A. Interior Acrylic Latex (Eggshell): MPI #144.

B. Interior Acrylic Latex (Semigloss): MPI #147.

C. Interior High-performance architectural (Eggshell): MPI #139.

D. Interior Acrylic Latex (Gloss): MPI #114.

E. High Performance Architectural Latex: MPI #141.

F. Interior water-based gloss: MPI #154.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Wood: 15 percent.
   2. Plaster and Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Verify that plaster is fully cured.

E. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

   1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
   2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

   1. Remove mildew before painting by washing with a solution of 1 part liquid household bleach and 3 parts of warm water. Apply the solution and scrub the mildewed area. Allow the solution to remain on the surface for 10 minutes. Rinse thoroughly with clean water and allow the surface to dry 48 hours before painting. Wear protective glasses or goggles, waterproof gloves, and protective clothing. Quickly wash off any of the mixture that comes in contact with your skin. Do not add detergents or ammonia to the bleach/water solution.
   2. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

E. Wood Substrates:

   1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
   2. Sand surfaces that will be exposed to view, and dust off.
   3. Prime edges, ends, faces, undersides, and backsides of wood.
   4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

F. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

G. Plaster Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

3.3 APPLICATION

A. Apply paints and coatings according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:

1. Mechanical Work:

a. Uninsulated metal piping.
b. Uninsulated plastic piping.
c. Pipe hangers and supports.
d. Tanks that do not have factory-applied final finishes.
e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

2. Plumbing Work:

a. Uninsulated metal piping.
b. Uninsulated plastic piping.
c. Pipe hangers and supports.
d. Tanks that do not have factory-applied final finishes.
e. Equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
f. Plumbing equipment that is indicated to have a factory-primed finish for field painting.

3. Electrical Work:

a. Switchgear.
b. Panelboards.
c. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.4 FIELD QUALITY CONTROL

A. Testing of Paint Materials: The Owner reserves the right to invoke the following procedure at any time and as often as deemed necessary during the period when paints are being applied:

1. Engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.

2. Testing agency will perform tests for compliance with product requirements.
3. The Owner may direct the Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Professional, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Steel Substrates:

1. Quick-Drying Enamel System:

a. Prime Coat: Quick-drying alkyd metal primer, MPI #76, SW Protective & Marine Kem Bond HS Universal Alklyd Primer
b. Intermediate Coat: Quick-drying enamel matching topcoat.
c. Topcoat: Light Industrial Coating, Interior, Waterbased, (Gloss Level 6), MPI #154, SW Pro Industrial Acrylic Gloss.

B. High-Performance Architectural Latex System:

a. Prime Coat: Primer, latex, for interior wood, MPI #39. SW Multi Purpose Latex Primer/Sealer
b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5), MPI #141. SW Pro Industrial Acrylic Semi Gloss Coating.

C. Wood Trim and Panel Substrates: Including painted plywood, medium-density fiberboard and hardboard.

1. Alkyd System:

a. Prime Coat: Primer, latex for interior woodwork, MPI #39. SW Multi Purpose Latex Primer/Sealer
b. Intermediate Coat: Latex, interior matching top coat.
c. Topcoat: Latex, interior High Performance (Gloss Level 3), MPI #139. SW Pro Industrial Pre-Calalyzed Waterbased Epoxy Eg-Shel.

D. Gypsum Board and Plaster Substrates:

1. High Performance Architectural Latex Over Latex Primer System:

a. Prime Coat: Interior latex primer/sealer, MPI #50. Pro Mar 200 zero VOC Interior Latex Primer.
b. Intermediate Coat: Interior latex matching topcoat.

c. Topcoat: Interior latex, high performance architectural (Gloss Level 3), MPI #44. SW Pro Mar 200 Zero VOC Eg-Shel.

E. Gypsum Board Ceiling Substrate in Breakroom 213:

1. High Performance Architectural Latex Over Drywall Surfacer:

a. First Coat: Speedhide MaxBuild High Build Drywall Surfacer
   1. Replacement surfacers for skim coat joint compound application and primer.
   2. Applied according to recommended spread rates to achieve a GA-214 ASTM C840 Level 5 gypsum board finish.

b. Topcoat: Interior latex, high performance architectural product, recommended by manufacturer, (Matte Finish)

END OF SECTION 09 91 23

SECTION 09 93 00 - WOOD STAINS AND TRANSPARENT FINISHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and application of wood finishes on the following substrates:

1. Interior Substrates:

a. Dressed lumber (finish carpentry or woodwork).
b. Wood-based panel products

B. Related Requirements:

1. Section 09 01 90.52 “Maintenance Painting’ for preparation and stain on existing materials.
2. Section 09 91 23 "Interior Painting" for stains and transparent finishes on concrete floors.

1.3 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

D. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.

B. Samples for Initial Selection: For each type of product indicated.

C. Product List: For each product indicated, include the following:

1. Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the product proposed for use highlighted.
3. VOC content.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Stains and Transparent Finishes: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of stain color selections will be based on mockups.

a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply finishes when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

C. Do not apply exterior finishes in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore & Co.
2. Duron, Inc.
3. PPG Architectural Finishes, Inc.
4. Sherwin-Williams Company (The).

2.2 MATERIALS, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each finish system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a finish system, provide products recommended in writing by manufacturers of topcoat for use in finish system and on substrate indicated.
3. Primers, Sealers, and Undercoaters: 200 g/L.

C. Stain Colors: As selected by Architect from manufacturer's full range.

2.3 SOURCE QUALITY CONTROL

A. Testing of Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample wood finishing materials. Contractor will be notified in advance and may be present when samples are taken. If materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying wood finishes if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying materials from Project site, pay for testing, and refinish surfaces finished with rejected materials. Contractor will be required to remove rejected materials from previously finished surfaces before refinishing with complying materials if the two finishes are incompatible or produce results that, in the opinion of the Architect, are aesthetically unacceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Interior Wood Substrates: 13 percent, when measured with an electronic moisture meter.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with finish application only after unsatisfactory conditions have been corrected.

1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.

1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

D. Interior Wood Substrates:

1. Scrape and clean knots and apply coat of knot sealer before applying primer.

2. Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.
3. Sand surfaces that will be exposed to view and dust off.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for finish and substrate indicated.
2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood Substrates: General for floor, trim, and wainscot. Confirm existing conditions / wood-finish to confirm capability with the following:

1. Stain: Minwax Performance Series Tintable Wood Stain 250 VOC

a. First Clear Coat: Minwax Water-based Oil-modified Polyurethane
b. Second Clear Coat: Minwax Water-based Oil-modified Polyurethane

1) Confirm satin, semi-gloss, or gloss with Architect prior to mock-up

B. Wood Substrates: Wood trim and architectural woodwork

1. Solid-Color, Water-Based Stain System MPI EXT 6.3K:

a. Prime Coat: Primer, alkyd for exterior wood MPI #5.
b. Intermediate Coat: Stain, exterior, water based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, water based, solid hide MPI #16.

2. Solid-Color, Solvent-Based Stain System MPI EXT 6.3C:

a. Prime Coat: Primer, alkyd for exterior wood MPI #5.
b. Intermediate Coat: Stain, exterior, solvent based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, solvent based, solid hide MPI #14.

3. Water-Based Semitransparent Stain System MPI EXT 6.3N:

    a. Prime Coat: Stain, exterior, water based, semitransparent, matching topcoat.
    b. Intermediate Coat: Stain, exterior, water based, semitransparent, matching topcoat.
    c. Topcoat: Stain, exterior, water based, semitransparent MPI #156.

4. Semitransparent Stain System MPI EXT 6.3D:

    a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.
    b. Topcoat: Stain, exterior, solvent based, semitransparent MPI #13.

5. Varnish over Stain System MPI EXT 6.3E:

    a. Stain Coat: Stain, exterior, solvent-based, semitransparent MPI #13.
    b. First Intermediate Coat: Varnish matching topcoat.
    c. Second Intermediate Coat: Varnish matching topcoat.
    d. Topcoat: Varnish, with UV inhibitor, exterior, semi-gloss (MPI Gloss Level 5) MPI #30.
    e. Topcoat: Varnish, with UV inhibitor, exterior, gloss (MPI Gloss Level 6) MPI #29.
    f. Topcoat: Varnish, marine spar, exterior, gloss (MPI Gloss Level 7) MPI #28.

6. Water-Based Varnish System MPI EXT 6.3M:

    a. Prime Coat: Water-based varnish matching topcoat.
    b. Intermediate Coat: Water-based varnish matching topcoat.
    c. Topcoat: Water-based varnish (MPI Gloss Level 1) MPI #191.
    d. Topcoat: Water-based varnish (MPI Gloss Level 2) MPI #192.
    e. Topcoat: Water-based varnish (MPI Gloss Level 3) MPI #193.
    f. Topcoat: Water-based varnish (MPI Gloss Level 4) MPI #194.
    g. Topcoat: Water-based varnish (MPI Gloss Level 5) MPI #195.
    h. Topcoat: Water-based varnish (MPI Gloss Level 6) MPI #196.
    i. Topcoat: Water-based varnish (MPI Gloss Level 7) MPI #197.

7. Varnish System [MPI EXT 6.3F]:

    a. Prime Coat: Varnish matching topcoat.
    b. First Intermediate Coat: Varnish matching topcoat.
    c. Second Intermediate Coat: Varnish matching topcoat.
    d. Topcoat: Varnish, with UV inhibitor, exterior, semi-gloss (MPI Gloss Level 5) MPI #30.
    e. Topcoat: Varnish, with UV inhibitor, exterior, gloss (MPI Gloss Level 6) MPI #29.
    f. Topcoat: Varnish, marine spar, exterior, gloss (MPI Gloss Level 7) MPI #28.

8. Clear, Two-Component Polyurethane Varnish System MPI EXT 6.3G:

    a. Prime Coat: Varnish, aliphatic polyurethane, two component, matching topcoat.
    b. Topcoat: Varnish, aliphatic polyurethane, two component (MPI Gloss Level 6 or 7) MPI #78.

C. Wood Substrates: Wood-based panel products.

1. Solid-Color, Water-Based Stain System MPI EXT 6.4A:

    a. Prime Coat: Primer, latex for exterior wood MPI #6.
    b. Prime Coat: Primer, alkyd for exterior wood MPI #5.
    c. Intermediate Coat: Stain, exterior, water based, solid hide, matching topcoat.
    d. Topcoat: Stain, exterior, water based, solid hide MPI #16.

2. Solid-Color, Solvent-Based Stain System MPI EXT 6.4C:

    a. Prime Coat: Primer, alkyd for exterior wood MPI #5.

b. Intermediate Coat: Stain, exterior, solvent based, solid hide, matching topcoat.
c. Topcoat: Stain, exterior, solvent based, solid hide MPI #14.

3. Water-Based Semitransparent Stain System MPI EXT 6.4L:

a. Prime Coat: Stain, exterior, water based, semitransparent, matching topcoat.
b. Intermediate Coat: Stain, exterior, water based, semitransparent, matching topcoat.
c. Topcoat: Stain, exterior, water based, semitransparent MPI #156.

4. Semitransparent Stain System MPI EXT 6.4D:

a. Prime Coat: Stain, exterior, solvent based, semitransparent, matching topcoat.
b. Topcoat: Stain, exterior, solvent based, semitransparent MPI #13.

5. Varnish over Stain System MPI EXT 6.4J:

a. Stain Coat: Stain, exterior, solvent based, semitransparent MPI #13.
b. First Intermediate Coat: Varnish matching topcoat.
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, with UV inhibitor, exterior, semi-gloss (MPI Gloss Level 5) MPI #30.
e. Topcoat: Varnish, with UV inhibitor, exterior, gloss (MPI Gloss Level 6) MPI #29.
f. Topcoat: Varnish, marine spar, exterior, gloss (MPI Gloss Level 7) MPI #28.

6. Varnish System MPI EXT 6.4H:

a. Prime Coat: Varnish matching topcoat.
b. First Intermediate Coat: Varnish matching topcoat.
c. Second Intermediate Coat: Varnish matching topcoat.
d. Topcoat: Varnish, with UV inhibitor, exterior, semi-gloss (MPI Gloss Level 5) MPI #30.
e. Topcoat: Varnish, with UV inhibitor, exterior, gloss (MPI Gloss Level 6) MPI #29.
f. Topcoat: Varnish, marine spar, exterior, gloss (MPI Gloss Level 7) MPI #28.

D. Wood Substrates: Traffic surfaces including decking and stairs.

1. Deck Stain over Wood Preservative System MPI EXT 6.5D:

a. Preservative Coat: Preservative, for exterior wood MPI #37.
b. Intermediate Coat: Stain, for exterior wood decks, matching topcoat.
c. Top coat: Stain, for exterior wood decks MPI #33.

2. Deck Stain System MPI EXT 6.5F:

a. Prime Coat: Stain, for exterior wood decks, matching topcoat.
b. Top coat: Stain, for exterior wood decks MPI #33.

END OF SECTION 09 93 00

SECTION 10 11 00 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Magnetic markerboards.
2. Tack Boards.

1.3 DEFINITIONS

A. Visual Display Board Assembly: Visual display surface that is factory fabricated into composite panel form, either with or without a perimeter frame; includes tackboards, markerboards.

B. Visual Display Surface: Surfaces that are used to convey information visually, including surfaces of markerboards and surfacing materials that are not fabricated into composite panel form but are applied directly to walls.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for visual display surfaces.

B. Shop Drawings: For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.

1. Show locations of panel joints.
2. Include sections of typical trim members.

C. Samples for Initial Selection: For each type of visual display surface indicated, for units with factory-applied color finishes, and as follows:

1. Include accessory Samples to verify color selected.

D. Samples for Verification: For each type of visual display surface indicated.

1. Visual Display Surface: Not less than 8-1/2 by 11 inches (215 by 280 mm), mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.
2. Trim: 6-inch-(152-mm-) long sections of each trim profile.
3. Display Rail: 6-inch-(152-mm-) long sections.
4. Accessories: Full-size Sample of each type of accessory.

E. Product Schedule: For visual display surfaces.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of fabrics.

C. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For visual display surfaces to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of motor-operated, sliding visual display units required for this Project.

B. Source Limitations: Obtain visual display surfaces from single source from single manufacturer.

C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

D. Pre-installation Conference: Conduct conference at Project site.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-built visual display surfaces, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, pre-fit components at the factory, disassemble for delivery, and make final joints at the site.

B. Store visual display surfaces vertically with packing materials between each unit.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display surfaces until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Field Measurements: Verify actual dimensions of construction contiguous with visual display surfaces by field measurements before fabrication.

1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.10 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Surfaces lose original writing and erasing qualities.
b. Surfaces exhibit crazing, cracking, or flaking.

2. Warranty Period: Life of the building.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Porcelain-Enamel Face Sheet: Porcelain-enamel-clad, ASTM A 463/A 463M, Type 1, stretcher-leveled aluminized steel, with 0.024-inch (0.60-mm) uncoated thickness; with porcelain-enamel coating fused to steel at approximately 1000 deg F (538 deg C).

1. Gloss Finish: Low gloss; dry-erase markers wipe clean with dry cloth or standard eraser. Suitable for use as projection screen.

a. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1) Claridge Products and Equipment, Inc.; LCS Markerboard.

B. Hardboard: ANSI A135.4, tempered.

C. Particleboard: ANSI A208.1, Grade M-1., made with binder containing no urea formaldehyde.

D. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063.

E. Adhesives: Manufacturer's standard product that complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 MAGNETIC MARKERBOARD ASSEMBLIES (GENERAL MARKERBOARDS)

A. Porcelain-Enamel Markerboards: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and 0.021-inch thick porcelain-enamel face sheet with high-gloss finish.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Best-Rite Manufacturing.
b. Claridge Products and Equipment, Inc.
c. PolyVision Corporation; a Steelcase company.
d. American Visual Display.
e. Newline Products, Inc.
f. AARCO Products, Inc.

2. Fiberboard Core: 1/2 inch (13 mm) thick; with manufacturer's standard moisture-barrier backing.
3. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.

2.3 MAGNETIC MARKERBOARD ASSEMBLIES (CONFERENCE ROOMS)

A. Glass Wall-Mounted Markerboards: ¼” low-iron, ultra-clear glass, invisible-mounting, scratch & stain resistant with magnetic surface.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Best-Rite Manufacturing.
b. Claridge Products and Equipment, Inc.
c. PolyVision Corporation; a Steelcase company.
d. American Visual Display.
e. Newline Products, Inc.

f. AARCO Products, Inc.

2.4 TACKBOARD ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Best-Rite Manufacturing.
2. Claridge Products and Equipment, Inc.
3. PolyVision Corporation; a Steelcase company.
4. American Visual Display
5. Newline Products, Inc.
6. AARCO Products, Inc.

B. Plastic-Impregnated-Cork Tackboard: 1/4-inch-(6-mm-) thick, plastic-impregnated cork sheet factory laminated to 1/4-inch-(6-mm-) thick particleboard backing.

2.5 MARKERBOARD ACCESSORIES

A. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch-(1.57-mm-) thick, extruded aluminum; standard size and shape.

1. Field-Applied Trim: Manufacturer's standard, snap-on trim with no visible screws or exposed joints.
2. Factory-Applied Trim: Manufacturer's standard.

2.6 FABRICATION

A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.

B. Visual Display Boards: Factory assemble visual display boards unless otherwise indicated.

1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.

C. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.

1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board.
2. Provide manufacturer's standard vertical-joint spline system between abutting sections of markerboards.
3. Provide manufacturer's standard mullion trim at joints between markerboards of combination units.
4. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.

D. Modular Visual Display Boards: Fabricated with integral panel clips attached to core material.

E. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.

1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

B. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.9 VISUAL DISPLAY SURFACE SCHEDULE

A. Visual Display Board.

1. Magnetic markerboard: Porcelain-enamel markerboard assembly.

   a. Color: White.

2. Corners: Square.
3. Width: As indicated on Drawings.
4. Height: As indicated on Drawings.
5. Mounting: Wall.
6. Mounting Height: As indicated on Drawings.
7. Factory / Field-Applied Aluminum Trim: Manufacturer's standard with clear anodic finish.
8. Accessories:

   a. Chalktray: Box type.
   b. Map rail with display rail, end stops, map hooks and clips, and flag holder.
   c. Exposed spline will not be permitted at joint between markerboard panels.

B. Visual Display Board.

1. Magnetic Glass Markerboard: Glass markerboard assembly

   a. Color: White

2. Corners: Square
3. Width: As indicated on Drawings
4. Height: As indicated on Drawings
5. Mounting: Wall – invisible mounting
6. No frame/ trim
7. Accessories:

   a. Magnetic Slim Marker Caddy
   b. Magnetic Eraser

C. Tackboard:

1. Tack Surface: Plastic-impregnated-cork tackboard assembly.

    a. Color: As selected by Architect from full range of industry colors.

2. Corners: Square.
3. Width: As indicated on Drawings.
4. Height: As indicated on Drawings.
5. Mounting: Wall.
6. Mounting Height: As indicated on Drawings.
7. Edges: Concealed by trim.

    a. Field-Applied Aluminum Trim: Manufacturer's standard style, with clear anodic finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of motor-operated, sliding visual display units.

C. Examine walls and partitions for proper preparation and backing for visual display surfaces.

D. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair the performance of and affect the smooth, finished surfaces of visual display boards, including dirt, mold, and mildew.

C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display surfaces and wall surfaces.

1. Prime wall surfaces indicated to receive direct-applied, visual display wall panels and as recommended in writing by primer/sealer manufacturer and wall covering manufacturer.
2. Prepare substrates indicated to receive visual display wall covering as required by manufacturer's written instructions to achieve a smooth, dry, clean, structurally sound surface that is uniform in color.

    a. Moisture Content: Maximum of 4 percent when tested with an electronic moisture meter.
    b. Metals: If not factory primed, clean and apply metal as recommended in writing by primer/sealer manufacturer and wall covering manufacturer.
    c. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall covering manufacturer.
    d. Painted Surfaces: Treat areas susceptible to pigment bleeding.

3.3 INSTALLATION, GENERAL

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawing. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

3.4 CLEANING AND PROTECTION

A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION 10 11 00

SECTION 10 14 16 - PLAQUES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes metal plaques.

1.3 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For plaques.

1. Include fabrication and installation details and attachments to other work.
2. Show plaque mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each plaque at least half size.

C. Samples for Initial Selection: For each type of plaque, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

1.5 INFORMATIONAL SUBMITTALS

1.6 CLOSEOUT SUBMITTALS

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of plaques that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering.
b. Deterioration of embedded graphic image.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.2 PLAQUES

A. Etched Plaque PL-1 Chemically etched or photochemically engraved metal sheet or plate with texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. A.R.K. Ramos.
    b. ACE Sign Systems, Inc.
    c. Erie Landmark Company; a division of Paul W. Zimmerman Foundries.
    d. Gemini Incorporated.
    e. iSIGNS, Inc.
    f. Metallic Arts.
    g. Nelson-Harkins Industries.
    h. Signs & Decal Corp.
    i. Southwell Company (The).
    j. Steel Art Company.

2. Plaque Material: Sheet or plate bronze.
3. Plaque Size: Refer to Drawings.
4. Plaque Thickness: 0.250 inch(6.35 mm).
5. Finishes:

    a. Integral Metal Finish: As selected by Architect from full range of industry finishes.
    b. Integral Aluminum Finish: Medium bronze anodized.
    c. Integral Stainless-Steel Finish: No. 8.
    d. Overcoat: Clear organic coating.

6. Integral Edge Style: Square cut, polished.
7. Mounting: Adhesive.

2.3 MATERIALS

A. Bronze Castings: ASTM B 584, alloy recommended by manufacturer and finisher for finish indicated.

B. Bronze Plate: ASTM B 36/B 36M, alloy recommended by manufacturer and finisher for finish indicated.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of plaques, noncorrosive and compatible with each material joined, and complying with the following:

1. Plaque Mounting Fasteners:

    a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of plaque, screwed into back of plaque, or screwed into tapped lugs cast integrally into back of plaque unless otherwise indicated.
    b. Through Fasteners: Exposed metal fasteners matching plaque finish, with type of head indicated, installed in predrilled holes.

B. Adhesive: As recommended by plaque manufacturer.

C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.

2.5 FABRICATION

A. General: Provide manufacturer's standard plaques according to requirements indicated.

1. Preassemble plaques in the shop to greatest extent possible. Disassemble plaques only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
5. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match plaque finish.
6. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

B. Surface-Engraved Graphics: Machine-engrave characters and other graphic devices into indicated plaque surface to produce precisely formed copy, incised to uniform depth.

1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.

C. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted plaques to suit plaque construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match plaque-background color color unless otherwise indicated.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Verify that plaque-support surfaces are within tolerances to accommodate plaques without gaps or irregularities between backs of plaques and support surfaces unless otherwise indicated.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install plaques using mounting methods indicated and according to manufacturer's written instructions.

1. Install plaques level, plumb, true to line, and at locations and heights indicated, with plaque surfaces free of distortion and other defects in appearance.
2. Install plaques so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that plaque surfaces are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of plaque. Remove loose debris from hole and substrate surface.

   a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place plaque in position and push until flush to surface, embedding studs in holes. Temporarily support plaque in position until adhesive fully sets.
2. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of plaque and of suitable quantity to support weight of plaque after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as plaque is applied and to prevent visibility of cured adhesive at plaque edges. Place plaque in position, and push to engage adhesive. Temporarily support plaque in position until adhesive fully sets.
3. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of plaque and of suitable quantity to support weight of plaque without slippage. Keep strips away from edges to prevent visibility at plaque edges. Place plaque in position, and push to engage tape adhesive.

END OF SECTION 10 14 16

SECTION 10 14 19 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cast dimensional characters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For dimensional letter signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.
4. Show locations of electrical service connections.
5. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Dimensional Characters: Full-size Sample of dimensional character.
2. Exposed Accessories: Full-size Sample of each accessory type.

E. Sign Schedule: Use same designations specified or indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer of products.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering.
b. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design sign structure and anchorage of rooftop dimensional character sign type(s) to withstand design loads as indicated on Drawings.

B. Thermal Movements: For exterior, allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 DIMENSIONAL CHARACTERS

A. Cast Characters: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. A. R. K. Ramos Signage Systems.
b. ACE Sign Systems, Inc.
c. ASI Sign Systems, Inc.
d. APCO Graphics, Inc.
e. Gemini Incorporated.
f. Matthews International Corporation; Bronze Division.
g. Metal Arts; Division of L & H Mfg. Co.
h. Metallic Arts.
i. Southwell Company (The).

2. Character Material: Cast aluminum.
3. Typeface: Times New Roman or as shown on drawings
4. Character Height: as shown on drawings
5. Thickness: Manufacturer's standard for size of character.
6. Finishes:

a. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.

7. Mounting: Projecting studs, unless otherwise noted

2.3 DIMENSIONAL CHARACTER MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.

B. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

D. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish nonferrous-metal or hot-dip galvanized devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

   a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
   b. Fastener Heads: For nonstructural connections, use flathead countersunk screws and bolts with tamper-resistant slots unless otherwise indicated.

4. Sign Mounting Fasteners:

   a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
   b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
   c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
2. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
3. Internally brace signs for stability and for securing fasteners.
4. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
5. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

B. Color Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 10 14 19

SECTION 10 14 23 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Room-identification signs, and other accessible signage.

B. Related Requirements:

1. Section 22 05 53 "Identification for Plumbing Piping and Equipment" for labels, tags, and nameplates for plumbing systems and equipment.
2. Section 26 05 53 "Identification for Electrical Systems" for labels, tags, and nameplates for electrical equipment.

1.3 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION

A. Furnish templates and tolerance information for placement of sign-anchorage devices embedded in permanent construction by other installers.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For panel signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Room-Identification Signs: Full-size Sample.
2. Exposed Accessories: Full-size Sample of each accessory type.
3. Frames: Full-size Sample.

E. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer of products and installers who are trained and approved by manufacturer.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices and electrical service embedded in permanent construction by other installers by field measurements before fabrication and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering.
b. Deterioration of embedded graphic image.
c. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

B. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.

2.2 SIGNS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ace Sign Systems, Inc.
2. APCO Graphics, Inc.
3. ASI Sign Systems, Inc.
4. Bayuk Graphics.
5. Best Sign Systems Inc.
6. iSign, Inc.
7. Mohawk Sign Systems.

B. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated to acrylic backing sheet to produce composite sheet.

   a. Composite-Sheet Thickness: 1/8 inch thick.
   b. Surface-Applied Graphics: Applied vinyl film.
   c. Color(s): As selected by Architect from manufacturer's full range.

2. Sign-Panel Perimeter: Metal Framed.

   a. Metal Frame: Entire Perimeter and full rear face.

      1) Backer Panel:1/8 inch thick fire-resistant hardboard backer panel inside of frame.

   b. Frame Edge Condition: Square cut.
   c. Frame Thickness: 1/16 inch.
   d. Frame Depth: 3/4 inch minimum or as required to receive sheet sign and backer panel.

      1) Frame construction to be prepared to hold removable laminated-sheet sign where pocket inserts are indicated.

   e. Frame material: Aluminum.

      1) Finish: Clear

3. Mounting: Surface mounted to wall with concealed anchors or adhesive.

4. Text and Typeface: Accessible raised characters and Braille as selected by Architect from manufacturer's full range. Finish raised characters to contrast with background color, and finish Braille to match background color.

   a. Letter Style: to be selected by Architect from manufacturer’s full range.
   b. Letter Color: White. To be verified by Architect.
   c. Letter Size:

      1) 5/8 inch minimum.
      2) Accessibility Panel Signage: 3/4 inch typical, sized to fit.

2.3 PANEL-SIGN MATERIALS

A. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

B. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated and suitable for exterior applications.

C. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

D. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

E. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish hot-dip galvanized devices unless otherwise indicated.
3. Inserts: Furnish inserts to be set by other trades into concrete or masonry work.

B. Adhesives: As recommended by sign manufacturer and with a VOC content of 70 g/L or less for adhesives used inside the weatherproofing system and applied on-site when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Anchoring Materials:

1. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
2. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

   a. Water-Resistant Product: At exterior locations, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
4. Internally brace signs for stability and for securing fasteners.
5. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.

C. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:

1. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. Furnish two blank inserts for each sign for Owner's use. Subsequent changeable inserts are by Owner.
2. For frame to hold changeable sign panel, fabricate frame without burrs or constrictions that inhibit function.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

B. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Verify that anchor inserts are correctly sized and located to accommodate signs.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Room-Identification Signs and Other Accessible Signage: Install in locations on walls according to accessibility standards.

1. Review final sign locations with Owner prior to installation.

C. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.

D. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

3.4 ADA COMPLIANT ROOM PANEL SIGN SCHEDULE (FINAL ROOM NUMBERS AND NAMES WILL BE PROVIDED BY OWNER AT A LATER DATE.)

A. Offices and General Spaces: Provide and Install Room Signage outside each room door opening.

1. Sign Size: Not less than 6-inches by 6-inches, and as required to accommodate text size and length.
2. Text Format: Room Number and Room Designation.
3. Pocket Insert with Clear Cover: Acrylic insert, computer generated vinyl lettering.

B. Specialty Room Signs: Provide and Install Room Signage outside each room door opening.

1. Sign Size: Not less than 6-inches by 6-inches, and as required to accommodate text size and length.
2. Text Format: Room Number and Room Designation.

C. Corridor Wayfinding Signs: Provide and Install Wayfinding Signage.

1. Sign Size: Not less than 9-inches by 12-inches, and as required to accommodate text size and length.
2. Text Format: Room Numbers and Directionals.

D. Accessibility Signage, Restrooms, Accessible Route, Stairs, Elevator, Areas of Refuge, accessible entrances where not all entrances are accessible, location of accessible exits, each door to egress stairway and exit discharge, unisex toilet. Provide and Install Room Signage outside all accessible locations, and as required to meet the requirements of the Americans with Disabilities Act – 1990 (ADA) and ANSI A117.1.

1. Sign Size: Not less than 6-inches wide by 9-inches high, and as required to accommodate text size and length.
2. Text Format: Centered, Symbols and Room Designation.
3. Text Height: 3/4".
4. Symbols: 4-inch accessibility symbols and gender symbol (if applicable), with the verbal description placed directly below followed by Grade 2 Braille.

E. Entrance Signage, all Lobby Entrances and Vestibules: Provide and Install exterior-grade Room Signage outside Exterior Lobby Entrance doors:

1. Sign Size: Not less than 9-inches by 9-inches, and as required to accommodate text size and length.
2. Text Format: Centered, Symbols and Room Designation.

3. Symbols: 4-inch accessibility symbol with the verbal description “ENTRANCE” placed directly below followed by Grade 2 Braille.

F. Directional Signage: Provide directional signage indicating the route to the nearest like accessible element at the following locations: elevators, separate sex toilets indicating the location of the nearest accessible unisex toilets. General Contractor to verify all required locations with Authority Having Jurisdiction.

G. At areas of rescue assistance, provide signage at each door leading to an area of rescue assistance, at two-way communication stations, and provide instructional signage for two-way communication station.

H. Provide a tactile sign stating “EXIT” adjacent to each door to an egress stairway, an exit passageway and the exit discharge. General Contractor to verify all required locations with Authority Having Jurisdiction. Sign Size: not less than 3-inches high by 6-inches wide.

I. Not used

J. Areas of Assembly: Provide signage adjacent to the main exit or exit access doorway to include the permitted occupant load of that space.

K. Historic Rooms: Provide and Install Decorative Room Signage outside each room door opening.

1. Sign Size: Not less than 9-inches by 12-inches, and as required to accommodate text size and length.
2. Text Format: Room Number and Room Designation.
3. Style: Provide multi-material, layered sign with frame

3.5 ADDITIONAL SIGNAGE (PROVIDE IN CONTRACT)

A. Offices and General Spaces: two (2) additional

B. Specialty Room Signs: two (2) additional.

C. Corridor Wayfinding Signs: one (1) additional.

D. Accessibility Signage, Restrooms, Accessible Route, Stairs: one (1) additional

E. Entrance Signage, all Lobby Entrances and Vestibules: one (1) additional

F. Directional Signage: two (2) additional

G. At areas of rescue assistance: no additional required

H. Provide a tactile sign stating “EXIT” adjacent to each door to an egress stairway, an exit passageway and the exit discharge: four (4) additional.

I. Not used

J. Areas of Assembly: one (1) additional

K. Historic Rooms: no additional required

END OF SECTION 10 14 23

SECTION 10 22 39 - FOLDING PANEL PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Manually operated paired panel operable partition.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.

1.3 DEFINITIONS

A. NIC: Noise Isolation Class.

B. NRC: Noise Reduction Coefficient.

C. STC: Sound Transmission Class.

1.4 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For operable panel partitions.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.

C. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing.

1. Include Samples of accessories involving color selection.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Partition track, track supports and bracing, switches, turning space, and storage layout.
2. Suspended ceiling components.
3. Structural members to which suspension systems are attached.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:

a. Lighting fixtures.
b. HVAC ductwork, outlets, and inlets.
c. Speakers and smoke detectors.
d. Access panels.

B. Qualification Data: For qualified Installer.

C. Product Certificates: For each type of operable panel partition.

1. Include approval letter signed by manufacturer acknowledging Owner-furnished panel facing material complies with requirements.

D. Product Test Reports: For each operable panel partition, for tests performed by a qualified testing agency.

E. Field quality-control reports.

F. Sample Warranty: For manufacturer's special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

a. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
b. Seals, hardware, track, track switches, carriers, and other operating components.

1.8 MAINTENANCE MATERIAL

A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Panel Finish-Facing Material: Furnish full width in quantity to cover both sides of two panels when installed.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation of operable panel partitions.
b. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:

1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound- transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.
2. Noise-Reduction Requirements: Operable panel partition assembly, identical to partition tested for STC, tested for sound-absorption performance according to ASTM C 423, and rated for not less than the NRC indicated.

2.2 MANUALLY OPERATED, PAIRED PANEL OPERABLE PARTITIONS

A. Operable Acoustical Panels: Partition system, including panels, seals, finish facing, suspension system, operators, and accessories.

1. Basis-of-Design: Kwik Wall 3000 Series Panel Partition.
2. Architect will consider alternate products matching all specification requirements.

a. Modernfold Acousti-Seal Encore Panel Partition is an approved manufacturer.

B. Panel Operation: Manually operated.

Operating Force (ASTM E2068):

a. Swing Panel: Open 1 lbf (2.8 N) & Close 1 lbf (3.9 N)
b. Folding Panel:

1). Initiate Motion - Open 4 lbf (20 N) & Close 3 lbf (15 N)
2). Maintain Motion - Open 1 lbf (3 N) & Close 1 lbf (4 N)

C. Panel Construction: Roll-formed steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

D. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.

1. Panel Width: Equal widths.

E. STC: Not less than 56 in accordance with ASTM E90-85.

F. Panel Weight: 12 lb/sq. ft.

G. Panel Thickness: Not less than 4 inches (102 mm).

H. Panel Closure: Horizontally expanding panel edge with removable crank.

I. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.

2.3 SEALS

A. General: Provide seals that produce operable panel partitions complying with performance requirements and the following:

1. Manufacturer's standard seals unless otherwise indicated.
2. Seals made from materials and in profiles that minimize sound leakage.
3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.

B. Vertical Seals: Vertical Interlocking Sound Seals between panels: Roll-formed steel astragals, with reversible tongue and groove configuration in each panel edge for universal panel operation. Rigid plastic astragals or astragals in only one panel edge are not acceptable.

C. Horizontal Top Seals shall be automatic operable seals, manually operated top seals not permitted.

D. Horizontal Bottom Seals:

1. Manually activated seals providing normal 2” (51mm) operating clearance with an operating range of + 0.50” (13mm) to 1-50” (38mm). Seal shall be operable from panel edge or face. Extended seal shall exert nominal 120 pounds (265 kg) downward force to the floor throughout operating range.

2.4 PANEL FINISH FACINGS

A. Vinyl coated woven fabric wallcovering: Basis of design Upgrade Fabric

1. Color: As selected by Architect from manufacturer's full range of standard upgrade fabric patterns and colors.

B. Trimless Edges: Fabricate exposed panel edges so finish facing wraps uninterrupted around panel, covering edge and resulting in an installed partition with facing visible on vertical panel edges, without trim, for minimal sightlines at panel-to-panel joints.

2.5 SUSPENSION SYSTEMS

A. Individual Panels

1. Suspension Tracks: Minimum 11-gauge, 0.12-inch (3.04mm) roll-formed steel track, suitable for either direct mounting to an adjustable steel hanger brackets, supporting the load-bearing surface of the track, connected to structural support by pairs of 0.38-inch (10mm) diameter threaded rods. Aluminum track is not acceptable. Ninety-degree track intersections are not acceptable.

a. Exposed track soffit: Steel, integral to track, and pre-painted off-white.

2. Carriers: Two all-steel trolleys with steel-tired ball bearing wheels. Non-steel tires are not acceptable. Suspension system shall provide automatic indexing of panels into stack area using preprogrammed switches and trolleys without electrical, pneumatic, or mechanical activation.
3. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with ASTM E 557 except as otherwise required by operable panel partition manufacturer's written installation instructions.

B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.

C. Install panels from marked packages in numbered sequence indicated on Shop Drawings.

D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

E. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.

F. Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals. Perform test and make adjustments before NIC testing.

3.3 FIELD QUALITY CONTROL

A. NIC Testing: Engage a qualified testing agency to perform tests and inspections.

1. Testing Methodology: Perform testing of installed operable panel partition for noise isolation according to ASTM E 336, determined by ASTM E 413, and rated for not less than NIC indicated. Adjust and fit partitions to comply with NIC test method requirements.

B. An operable panel partition installation will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust operable panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.

B. Verify that safety devices are properly functioning.

3.5 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by manufacturer's authorized service representative. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operable-partition operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

END OF SECTION 10 22 39

SECTION 10 44 13 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

a. Portable fire extinguishers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.

B. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Initial Selection: For each type of exposed finish required.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples 6 by 6 inches (150 by 150 mm) square.

E. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Replacement Bubbles With Vinyl Lettering: Provide two (2).

1.6 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

2.2 FIRE-PROTECTION CABINET

A. Cabinet Type: Suitable for #10 multi-purpose dry chemical fire extinguisher.

1. Products: Basis-of-Design is Larsens Manufacturing. Subject to compliance with requirements, provide one of the following:

a. Larsens Manufacturing Company.
b. JL Industries, Inc.; a division of the Activar Construction Products Group
c. Potter Roemer LLC.

B. Cabinet Construction: Match wall construction for rated and non-rated fire walls.

C. Cabinet Material: Heavy gauged, white baked enamel.

D. Semi-recessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

1. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.

E. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.

F. Cabinet Trim Material: Extruded-aluminum shapes.

G. Door Style: Full acrylic bubble with vertical letters.

H. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide manufacturer's standard hinge permitting door to open 180 degrees.

I. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.

3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated below.

a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

1) Location: Applied to cabinet glazing.
2) Application Process: Silk-screened.
3) Lettering Color: Red.
4) Orientation: Vertical.

J. Materials:

1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

a. Finish: Baked enamel or powder coat.
b. Color: As selected by Architect from full range of industry colors and color densities.

2. Aluminum: ASTM B 221 (ASTM B 221M), with strength and durability characteristics of not less than Alloy 6063-T5 for aluminum sheet. ASTM B 221 (ASTM B 221M) for extruded shapes.

   a. Finish: Satin anodized.

2.3 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.
4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated.

1. Fire-Protection Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.

a. Verify height with authorities having jurisdiction prior to installation prep.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semi-recessed fire-protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 44 13

SECTION 10 44 16 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.
B. Related Requirements:

1. Section 10 44 13 "Fire Protection Cabinets."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Amerex Corporation.
b. Ansul Incorporated.
c. Badger Fire Protection.
d. JL Industries, Inc.; a division of the Activar Construction Products Group.
e. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
f. Larsens Manufacturing Company.

2. Valves: Manufacturer's standard.
3. Handles and Levers: Manufacturer's standard.
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

B. Multipurpose Dry-Chemical Type: UL-rated 10 lb. (4.5-kg) nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Amerex Corporation.
b. Ansul Incorporated.
c. Badger Fire Protection.
d. JL Industries, Inc.; a division of the Activar Construction Products Group.
e. Larsen’s Manufacturing Company.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: 54 inches (1372 mm) above finished floor to top of fire extinguisher.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 10 44 16

SECTION 10 56 13 - METAL STORAGE SHELVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Four-post metal storage shelving.

1.3 COORDINATION

A. Coordinate sizes and locations of blocking and backing required for installation of metal storage shelving attached to wall and ceiling assemblies.

B. Coordinate locations and installation of metal storage shelving that may interfere with ceiling systems including lighting, HVAC, speakers, sprinklers, access panels, electrical switches or outlets, and floor drains.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, construction details, material descriptions, dimensions of individual components and profiles, and finishes for metal storage shelving.

B. Shop Drawings: For metal storage shelving.

1. Include plans, elevations, sections, and attachment details.
2. Include installation details of connectors, lateral bracing, and special bracing.

C. Samples for Initial Selection: For each type of metal storage shelving with factory-applied color finishes.

1. Include Samples of accessories involving color selection.

D. Product Schedule: For metal storage shelving. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For seismic restraint of metal storage shelving.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of metal storage shelving.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal storage shelving to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Shelves: Full-size units equal to 5 percent of amount installed for each type indicated, but no fewer than 5 shelves.
2. Shelf-to-Post Connectors: Full-size units equal to 5 percent of amount installed for each type indicated, but no fewer than 10 connectors.
3. Shelf-Label Holders: Full-size units equal to 5 percent of amount installed for each type indicated, but no fewer than 10 holders.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install metal storage shelving until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for building occupants during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design metal storage shelving, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

2.2 FOUR-POST METAL STORAGE SHELVING

A. Open Four-Post Metal Storage Shelving : Complying with MH 28.1 and field assembled from factory-formed components. Shelves span between supporting corner posts that allow shelf-height adjustment over full height of shelving unit. Provide fixed top and bottom shelves, adjustable intermediate shelves, and accessories indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Borroughs Corporation.
b. Edsal Manufacturing Company, Inc.
c. Excalibur Wood Products.
d. Hodge.
e. Penco Products, Inc.
f. Spacesaver Corporation.
g. Tennsco.
h. UNICOR, Federal Prison Industries, Inc. (FPI).
i. Library Bureau Steel

2. Load-Carrying Capacity per Shelf: 700 lb(318 kg) .

3. Posts: Fabricated from hot-rolled steel; in manufacturer's standard shape; with perforations at 1-1/2 inches (38 mm) o.c. to receive shelf-to-post connectors.

a. Unit Configuration: Configure shelving units as individual, freestanding assemblies.

1) Add-On Shelf Posts: Fabricated from hot-rolled steel, manufacturer's standard shape; perforated to match main posts.

b. Post Base: Bolt leveler.

4. Bracing: Manufacturer's standard, single or double diagonal cross bracing.

a. Location: At unit back and ends as required for stability, load-carrying capacity of shelves, and number of shelves indicated.

5. Solid-Type Shelves:

a. Steel Sheet: Nominal thickness as required for load-carrying capacity per shelf.
b. Metallic-Coated Steel Sheet: Nominal thickness as required for load-carrying capacity per shelf.
c. Slots or Holes for Shelf Dividers: 2 inches (51 mm) o.c.
d. Fabricate fronts and backs of shelves with box-formed edges, with corners lapped and welded.
e. Fabricate fronts and backs of shelves with vertical edges that are flanged and returned, with edges reinforced with steel bars angles or channels.

6. Shelf Quantity: Five shelves per shelving unit in addition to top and bottom shelf.
7. Shelf-to-Post Connectors: Manufacturer's standard connectors.
8. Base: Open, with exposed post legs.
9. Overall Unit Size: As shown on Drawings.
10. Accessories:

a. Finished End Panels: Fabricated as perforated full-height panels from manufacturer's standard thickness cold-rolled steel sheet and with same finish as posts, with trim for a finished appearance along edges abutting posts and top shelf.
b. Shelf Dividers: Fabricated from same material and with same finish as shelves; tapered type.
c. Shelf-Label Holders: Clear plastic, designed to clip onto front edge of shelf.

11. Steel Finish: Baked enamel or powder coat.

a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.3 ANCHORS

A. Floor Anchors: Galvanized-steel, post-installed expansion anchors power-actuated fasteners or threaded concrete screws. Provide number per unit recommended by manufacturer unless additional anchors are indicated in calculations.

B. Wall Anchors: Manufacturer's standard, galvanized-steel anchors designed to secure metal storage shelving to adjacent wall. Provide one per shelving unit for each shelving unit adjacent to a wall unless additional anchors are indicated in calculations.

2.4 FABRICATION

A. Fabricate metal storage shelving components to provide field-assembled units that are square and rigid, with posts plumb and true and shelves flat and free of dents or distortion. Fabricate connections to form a rigid structure, free of buckling and warping.

1. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
2. Build in straps, plates, brackets, and other reinforcements as needed to support shelf loading.
3. Cut, reinforce, drill, and tap metal fabrications to receive hardware, fasteners, and similar items.

B. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work. Form backs of shelving units of up to 48 inches(1219 mm) wide from one piece.

C. Form edges and corners free of sharp edges or rough areas. Fold back and crimp exposed edges of unsupported sheet metal to form a hem on the concealed side; ease edges of metal plate to radius of approximately 1/32 inch (0.8 mm). Shear and punch metals cleanly and accurately. Remove burrs.

D. Weld corners and seams continuously to develop strength, minimize distortion, and maintain the corrosion resistance of base metals. At exposed locations, finish welds and surfaces smooth and blended so surface is smooth after finishing and contour of welded surface matches that of adjacent surface. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces before finishing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine floors for suitable conditions where metal storage shelving will be installed.

C. Examine walls and ceilings to which metal storage shelving will be attached for properly located blocking, grounds, or other solid backing for attachment of support fasteners.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Vacuum and clean finished floor over which metal storage shelving is to be installed.

3.3 INSTALLATION

A. Install metal storage shelving level, plumb, square, rigid, true, and with shelves flat and free of dents or distortion. Make connections to form a rigid structure, free of buckling and warping.

1. Install exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
2. Install braces, straps, plates, brackets, and other reinforcements as needed to support shelf loading and as required for stability.
3. Adjust post-base bolt leveler to achieve level and plumb installation.
4. Anchor shelving units to floor with floor anchors through floor plate. Shim floor plate to achieve level and plumb installation.
5. Install seismic restraints.
6. Connect side-to-side and back-to-back shelving units together.
7. Install shelves in each shelving unit at equal spacing.

    a. Four-Post Metal Storage Shelving: Install four clips, one at each post, for support of each shelf; with clips fully engaged in post perforations.

B. Accessories:

1. Install finished end panels and trim at exposed ends of shelving units.
2. Shelf Dividers: Install at equal spacing.
3. Shelf-Label Holders: Install one on each shelf.

    a. Install centered vertically aligned within each shelving unit.

3.4 ERECTION TOLERANCES

A. Erect four-post metal storage shelving to a maximum tolerance from vertical of 1/2 inch (13 mm) in up to 10 feet (3 m) of height, not exceeding 1 inch (25 mm) for heights taller than 10 feet (3 m).

3.5 ADJUSTING

A. Adjust metal storage shelving so that connectors and other components engage accurately and securely.

B. Adjust and lubricate operable components to operate smoothly and easily, without binding or warping. Check and readjust operating hardware.

C. Touch up marred finishes or replace metal storage shelving that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal storage shelving manufacturer.

D. Replace metal storage shelving components that have been damaged beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 56 13

SECTION 12 24 13 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Manually operated roller shades with single rollers and double rollers.
2. Shade fabric.

B. Related Requirements:

1. Section 06 10 53 "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
2. Section 07 92 00 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.3 REFERENCES

A. ASTM International (ASTM):

1. ASTM G21 and E 2180 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

B. National Fire Protection Association (NFPA):

1. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

C. Window Covering Manufacturers Association (WCMA):

1. ANSI/WCMA A100.1-2022- Safety of Window Covering Products; 2022.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

C. Samples: For each exposed product and for each color and texture specified, 10 inches (250 mm) long.

D. Samples for Initial Selection: For each type and color of shadeband material.

1. Include Samples of accessories involving color selection.

E. Product Schedule: For roller shades. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.9 WARRANTY

A. Roller Shade Hardware and Chain Warranty: Manufacturer's standard non-depreciating, transferrable warranty for interior shading.

1. Shade Hardware - 10 years unless otherwise indicated:
2. All Shadecloth: Manufacturer's standard 25-year warranty.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS AND DOUBLE ROLLERS

A. Manufacturers: Subject to compliance with requirements, undefined:

1. Draper Inc.
2. Hunter Douglas Contract.
3. Jackson's Window Shoppe, Inc.
4. Lutron Electronics Co., Inc.

5. MechoShade Systems, Inc.
6. Nysan Solar Control, Inc.; Hunter Douglas Company.

B. Basis of Design: Mecho/5 System as manufactured by Mecho.

1. Description: Manually operated fabric window shades.

   a. Shade Type: RS-3 Single Roller.
   b. Shade Type: RS-4 Multi-Banded Double Roller.
   c. Drop Position: Regular roll.
   d. Mounting: Wall and ceiling mounted.
   e. Size: As indicated on drawings.
   f. Fabric: As indicated under Shade Fabric section.

2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.

   a. Material: Steel, 1/8 inch (3 mm) thick.
   b. Double Roller Brackets: Configured for light-filtering and room-darkening shades in one opening.

      1) Light-Filtering Fabric: Room-side of opening.
      2) Room-Darkening Fabric: Glass-side of opening.
      3) Operating chain pulls for both fabrics configured for the same side of the window.

   c. Multiple Shade Band Operation: Provide hardware as necessary to operate more than one shade band using a single clutch operator.

3. Roller Tubes:

   a. Material: Extruded aluminum.
   b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
   c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
   d. Roller tubes to be capable of being removed and reinstalled without affecting roller shade limit adjustments.

4. Hembars: Designed to maintain bottom of shade straight and flat.

   a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.

5. Clutch Operator: Manufacturer's standard material and design integrated with bracket/brake assembly.

   a. Heavy-duty, 1/8” steel mounting bracket and integrated steel brake, clutch and sprocket assembly rigidly affix the shade support and user control to the building structure fully independent of the roller tube components.
   b. Permanently lubricated maintenance-free brake assembly employs an oil-impregnated steel hub with wrapped spring clutch.
   c. Brake must withstand minimum pull force of 50 pounds (22.7 kg) in the stopped position.
   d. Direct drive clutch requires no interstitial gear stages or plastic parts between the building structure and clutch ensuring reliable operation across the full range of shade sizes.
   e. Maximum shade hanging weight of 18 pounds (8.2 kg).

6. Drive Chain: Continuous loop stainless steel beaded ball chain, 100 pound (45 kg) minimum breaking strength. Provide upper and lower limit stops.

    a. Chain Tensioner: Chain tensioning device complying with ANSI/WCMA A100.1-2022.
    b. Limit stops: Bead stops affixed to the chain maintain consistent shadeband alignment at the top and bottom of shade travel across multiple shades and help prevent shade damage resulting from unmanaged user control.

7. Accessories:

    a. Fascia: Removable extruded aluminum fascia, size as required to conceal shade mounting, attachable to brackets without exposed fasteners.

        1) Can be installed across two or more shade bands in one piece.
        2) Single Fascia: Accommodate regular roll shades.
        3) Profile: Square.
        4) Configuration: Continuous, fascia extends past continuous bracket.

2.3 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

1. Source: Roller shade manufacturer.
2. Type: PVC-coated fiberglass.
3. Weave: Mesh.
4. Weight: 12 oz/square yard.
5. Roll Width: to match width of window opening.
6. Orientation on Shadeband: Up the bolt.
7. Openness Factor: 5 percent.
8. Color: As selected by Architect from manufacturer's full range.

C. Light-Blocking Fabric: Opaque fabric, stain and fade resistant.

1. Source: Roller shade manufacturer.
2. Type: Fiberglass textile with PVC film bonded to both sides.
3. Weight: 12 oz/square yard.
4. Roll Width: To match width of window opening.
5. Orientation on Shadeband: Up the bolt.
6. Features: Washable.
7. Color: As selected by Architect from manufacturer's full range.

2.4 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch (6 mm) per side or 1/2-inch (13-mm) total, plus or minus 1/8 inch (3.1 mm). Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm).
2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4 , provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
2. Skylight Shades: Provide battens and seams at uniform spacings along shadeband as required to ensure shadeband tracking and alignment through its full range of movement without distortion or sag of material.
3. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

1. Opaque Shadebands: Located so shadeband is not closer than 2 inches(51 mm) to interior face of glass. Allow clearances for window operation hardware.

B. Roller Shade Locations: As indicated on Drawings.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 12 24 13

SECTION 12 35 40 - MANUFACTURED PLASTIC-LAMINATE-FACED CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes plastic-laminate-faced cabinets of stock design.

B. Related Requirements:

1. Section 06 10 53 "Miscellaneous Rough Carpentry" or wood blocking for anchoring casework.
2. Section 09 22 16 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring casework.
3. Section 09 65 13 "Resilient Base and Accessories" for resilient base applied to plastic-laminate-faced casework.
4. Section 12 36 61 “Solid Surface Panels” for solid surface countertops.
5. Section 22 40 00 “Plumbing Fixtures” for Sinks and Fixtures.

1.3 DEFINITIONS

A. Definitions in the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" apply to the work of this Section.

B. MDF: Medium-density fiberboard.

C. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive, and faced both front and back with hardwood veneers.

1.4 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

B. Keying Conference: Conduct conference at Project site. Incorporate keying conference decisions into final keying requirements.

1.5 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that casework can be supported and installed as indicated.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show fabrication details, including types and locations of hardware. Show installation details, including field joints and filler panels. Indicate manufacturer's catalog numbers for casework.

C. Keying Schedule: Include schematic keying diagram and index each key set to unique designations that are coordinated with the Contract Documents.

D. Samples: For cabinet finishes.

E. Samples for Initial Selection: For cabinet finishes.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer that is certified for chain of custody by an FSC-accredited certification body.

B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation of units required for this Project.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.

B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.10 MAINTENANCE MATERIAL

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Provide one unopened box of each of the following:

a. Shelf Clips
b. Locks

1.11 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period. Maintain temperature and relative humidity during the remainder of the construction period in range recommended for Project location by the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

B. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

C. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed and indicate measurements on Shop Drawings.

1.12 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of casework that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Delamination of components or other failures of glue bond.

b. Warping of components.
c. Failure of operating hardware.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufactured Plastic Laminate Faced Casework: Subject to requirements, provide Stevens Industries, Inc, or provide equal products by one of the following:

1. Case Systems
2. TMI Systems Design Corporation
3. Advanced Cabinet Systems (ACS)
4. AmeriCase
5. Mastercraft

B. Source Limitations: Obtain plastic-laminate-faced cabinets from single manufacturer.

2.2 CASEWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" for grades of casework indicated for construction, finishes, installation, and other requirements.

1. Grade: Custom.

B. Product Designations: Drawings indicate sizes, configurations, and finish materials of manufactured plastic-laminate-faced cabinets by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations, of same finish materials, and complying with the Specifications may be considered. See Section 01600 "Product Requirements."

C. Product Designations: Drawings indicate configurations of manufactured plastic-laminate-faced cabinets by referencing designations of Casework Design Series numbering system in Appendix A of the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

D. Furnish all cabinets and casework including tops, splashes and supporting structures and all other miscellaneous items of equipment as listed in the specifications or equipment schedules or as shown on the drawings. Fabricate and deliver to building, unload, unpack, set in place, level and securely fasten and scribe to walls as required; ready for mechanical and electrical connections which will be done as specified under other divisions. All work shall be strictly in accordance with this specification.

E. Holes in counters for insertion of sinks and fixtures will be the responsibility of the casework supplier.

2.3 CASEWORK

A. Design:

1. Full overlay, Basis-of-Design Stevens Series 2101.
2. Laminate Products: Product must have comparable color selections to basis-of-design listed on drawing finish legend.
3. Provide ADA sink enclosures per drawing details and in conjunction with accessibility requirements.

B. Grain Direction for Wood Grain Plastic Laminate:

1. Vertical on both doors and drawer fronts, with continuous vertical matching.
2. Lengthwise on face frame members.
3. Vertical on end panels.

4. Side to side on bottoms and tops of units.
5. Vertical on knee-space panels.
6. Vertical on aprons.

C. Exposed Materials:

1. Plastic Laminate: Grade HGS.

a. Colors for other cabinet surfaces, grade GP28. Refer to drawings for laminate manufacturer and color selections.
b. Colors for countertop grades, GP50 and PF42. Refer to drawings for laminate manufacturer and color selections.

2. Unless otherwise indicated, provide specified matching laminate edgebanding on all exposed edges.

3. Refer to Solid Surface Panels specification for countertops.

D. Semi-exposed Materials:

1. Plastic Laminate: Grade VGS unless otherwise indicated. Provide plastic laminate for semi-exposed surfaces unless otherwise indicated.

a. Provide plastic laminate of same grade as exposed surfaces for interior faces of doors and drawer fronts and other locations where opposite side of component is exposed. Interior face of doors to match exterior face material.

2. Unless otherwise indicated, provide specified edgebanding on all semi-exposed edges.

E. Concealed Materials:

1. Particleboard.

2.4 MATERIALS

A. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.

B. Hardwood Plywood: HPVA HP-1, particleboard core except where veneer core is indicated.

C. Softwood Plywood: DOC PS 1.

D. Particleboard: ANSI A208.1, Grade M-2.

E. MDF: ANSI A208.2, Grade 130.

F. Hardboard: ANSI A135.4, Class 1 Tempered.

G. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.

1. Manufacturers: Provide laminate selections as indicated on the finish plan drawings.

H. Edgebanding for Plastic Laminate: Square, self-edged plastic-laminate.

2.5 COLORS AND FINISHES

A. Plastic-Laminate Colors, Patterns, and Finishes: As selected by Architect from casework manufacturer's full range. Refer to Finish Plan drawings for selections.

2.6 CASEWORK HARDWARE AND ACCESSORIES

A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard satin-finish, commercial-quality, heavy-duty hardware.

1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.

B. Hinges: Concealed, self-closing, nickel-plated steel, minimum 120-degree opening, adjustable in three directions, suitable for full-overlay doors. Provide two hinges per door and additional hinges as required by door size and weight.

C. Pulls: Solid aluminum or chrome-plated brass bar pulls, fastened from back with two screws. For sliding doors, provide recessed chrome-plated flush pulls. Provide two pulls for drawers more than 24 inches (600 mm) wide.

1. Basis of design: Stevens Artisan Collection Modified Bar Pull – satin nickel

D. Drawer Slides: BHMA A156.9, Type B05091.

1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated, steel ball-bearing slides.

E. Drawer and Hinged Door Locks: Cylindrical (cam) type, five-pin tumbler, brass with chrome-plated finish, and complying with BHMA A156.11, Grade 1.

1. Provide a minimum of two keys per lock and six master keys.
2. Provide locks where indicated.

F. Adhesive shall have a VOC content of 50 g/L or les when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. Wall Mounted Standards: Provide channel type, extruded aluminum standard mounted om walls and designed to hold shelf support brackets inserted into channel ends or access slots and slid to desired position.

1. Mounting: Surface.
2. Length: As Indicated on Drawings.
3. Profile: Basic Channel .700 inch (18-mm) wide by .535 inch (14-mm) deep with projecting lips to retain shelf brackets and designed for surface mounting.

H. Shelf Support Brackets: Provide rectangular bracket fabricated from 1/4 inch (4 mm) thick extruded aluminum bar with steel pin to retain and hold bracket in support channel.

1. Depth: 2 inches (51 mm).
2. Finish: Clear Anodized.
3. Retaining Pins: 5/32 inch (4 mm) diameter by .3 inch (8 mm) long steel pin to secure shelf from shifting on bracket.
4. Shelf Couplers: 1 inch (25 mm) wide PVC extrusion pinned to top of bracket for supporting two adjoining shelves. Coupler is pre-drilled to allow shelves to be attached to screws. Color: Translucent.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CASEWORK INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Install casework level, plumb, and true; shim as required, using concealed shims. Where casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

C. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch (1.5 mm) of a single plane. Align similar adjoining doors and drawers to a tolerance of 1/16 inch (1.5 mm). Bolt adjacent cabinets together with joints flush, tight, and uniform.

D. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch (1.5 mm) of a single plane. Fasten to hanging strips, masonry, framing, wood blocking, or reinforcements in walls and partitions. Align similar adjoining doors to a tolerance of 1/16 inch (1.5 mm).

E. Fasten cabinets to adjacent cabinets and to masonry, framing, wood blocking, or reinforcements in walls and partitions to comply with the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

F. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.

G. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 INSTALLATION OF TOPS

A. Field Jointing: Where possible, make in the same manner as shop jointing using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project site processing of top and edge surfaces is not required. Locate field joints where shown on approved Shop Drawings.

B. Fastenings: Except for epoxy and phenolic-composite tops, use concealed clamping devices for field joints located within 6 inches of front, at back edges, and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

1. Secure tops, except for epoxy tops, to cabinets with Z-type fasteners or equivalent, using 2 or more fasteners at each front, end, and back.

C. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection. Provide flush hairline joints in tops using clamping devices.

1. Where necessary to penetrate tops with fasteners, countersink heads approximately 1/8 inch and plug hole flush with material equal to top in chemical resistance, hardness, and appearance.

D. Provide required holes and cutouts for service fittings.

E. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

F. Provide scribe moldings for closures at junctures of top, curb, and splash, with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.

3.4 INSTALLATION OF SINKS

A. Set top edge of sink unit in sink and top manufacturers' recommended chemical-resistant sealing compound and firmly secure to produce a tight and fully leakproof joint. Adjust sink and securely support to prevent movement.

B. Semi-flush Installation: Use stainless-steel sink frame, complete with clamping lugs and pads. Before setting, apply a full coat of sink and top manufacturers' recommended sealant under rim lip and along top. Omit sink frame if sink is fabricated with an integral rim seal.

C. Drop-in Installation: Rout groove in top to receive sink rim if not prepared in shop. Set sink in adhesive and fill remainder of groove with sealant or adhesive. Use procedures and products recommended by sink and top manufacturers. Remove excess adhesive and sealant while still wet and finish joint for neat appearance.

3.5 CLEANING

A. Repair or remove and replace defective work as directed on completion of installation.

B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

3.6 COORDINATION OF STORAGE SHELVING

A. Coordinate provision of shelving system with location of other wall and ceiling mounted components such as but not limited to visual display boards, casework, structural framing, light fixtures and air diffusers to eliminate potential conflicts.

B. Coordinate requirements for stud spacing, blocking and auxiliary structural supports to ensure adequate means for installation of shelving system.

C. Coordinate installation of shelving system with application of wall and ceiling finishes. To the extent possible install shelving components after finishes have been applied.

3.7 INSTALLATION OF STORAGE SHELVING

A. Install shelving system and accessories in accordance with approved shop drawings and manufacturers installation instructions.

B. Install shelving at locations and heights indicated on the drawings. Verify locations in field with Owner and Architect.

C. Install standards and other support components rigidly to supporting substrate so that components are secure, plumb and level.

D. Install with fasteners of type, size and quantity as supplied or recommended by shelving manufacturer for type of application and substrate.

E. Ensure screws used to anchor wall standards are set flush and do not project into channel.

F. Thoroughly clean and polish storage system components and protect from subsequent construction activities. Remove and replace damaged components.

3.8 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 12 35 40

SECTION 12 36 23.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad countertops.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings: For plastic-laminate-clad countertops.

1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
2. Show locations and sizes of cutouts and holes for items installed in plastic-laminate-clad countertops.
3. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples: Plastic laminates in each type, color, pattern, and surface finish required in manufacturer's standard size.

D. Samples for Initial Selection: For plastic laminates.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For the following:

1. Composite wood products.
2. High-pressure decorative laminate.
3. Chemical-resistant, high-pressure decorative laminate.
4. Adhesives.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.

B. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

C. Keep surfaces of countertops covered with protective covering during handling and installation.

1.7 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Environmental Limitations with Humidity Control: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during the remainder of the construction period.

C. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

D. Established Dimensions: Where countertops are indicated to fit to other construction, establish dimensions for areas where countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of plastic-laminate-clad countertops indicated for construction, finishes, installation, and other requirements.

1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that countertops comply with requirements of grades specified.
2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Grade: Custom.

C. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS.

D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As selected by Architect from manufacturer's full range in the following categories:

a. Solid colors and patterns, gloss matte finish.
b. Wood grains, gloss matte finish with grain running parallel to length of countertop.
c. Refer to architectural drawings for selections.

E. Edge Treatment: Square plastic-laminate self-edge.

F. Core Material: Particleboard.

G. Core Material at Sinks: Particleboard made with exterior glue or exterior-grade plywood.

H. Core Thickness: 3/4 inch (19 mm).

1. Build up countertop thickness to 1-1/2 inches (38 mm) at front, back, and ends with additional layers of core material laminated to top.

I. Backer Sheet: Provide plastic-laminate backer sheet, NEMA LD 3, Grade BKL, on underside of countertop substrate.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.

1. Wood Moisture Content: 8 to 13 percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of countertop and quality grade specified unless otherwise indicated.

1. MDF: Medium-density fiberboard, ANSI A208.2, Grade 130.
2. Particleboard: ANSI A208.1, Grade M-2 Grade M-2-Exterior Glue.
3. Softwood Plywood: DOC PS 1.

2.3 ACCESSORIES

A. Wire-Management Grommets: Circular, solid brass grommet liner and matching cap with slot for wire passage.
1. Outside Diameter: 1-1/4 inch (32 mm) 2 inches (51 mm).
2. Color: TBD from manufacturer's full range

2.4 MISCELLANEOUS MATERIALS

A. Adhesive for Bonding Plastic Laminate: As selected by fabricator to comply with requirements.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.5 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch (25 mm) over base cabinets. Ease edges to radius indicated for the following:

1. Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.

C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times countertop fabrication will be complete.
2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended, and check measurements of assemblies against field measurements before disassembling for shipment.

D. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of cutouts by saturating with varnish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing.

3.2 INSTALLATION

A. Grade: Install countertops to comply with same grade as item to be installed.

B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.

1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
2. Seal edges of cutouts by saturating with varnish.

C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

1. Secure field joints in countertops with concealed clamping devices located within 6 inches (150 mm) of front and back edges and at intervals not exceeding 24 inches (600 mm). Tighten in accordance with manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

D. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical-treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

F. Countertop Installation: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Install countertops level and true in line. Use concealed shims as required to maintain not more than a 1/8-inch-in-96-inches (3-mm-in-2400-mm) variation from a straight, level plane.
2. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c. and to walls with adhesive.
3. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.

B. Clean countertops on exposed and semiexposed surfaces.

C. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches (1220 mm) o.c. Remove protection at Substantial Completion.

END OF SECTION 12 36 23.13

SECTION 12 36 61.16 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid surface material countertops.
2. Solid surface material backsplashes.
3. Solid surface material end splashes.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials and sinks.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

C. Samples for Verification: For the following products:

1. Countertop material, 6 inches (150 mm) square.
2. Wood trim, (200 mm) long.
3. One full-size solid surface material countertop, with front edge and backsplash, 8 by 10 inches (200 by 250 mm), of construction and in configuration specified.

1.4 INFORMATIONAL SUBMITTALS

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.8 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Avonite Surfaces.
b. E. I. du Pont de Nemours and Company.
c. Formica Corporation.
d. LH Hausys
e. Meganite Inc.
f. Wilsonart LLC.

2. Type: Provide Standard type unless Special Purpose type is indicated.
3. Colors and Patterns: As indicated on finish drawings. Assume price group 4.

2.2 COUNTERTOP FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Custom.

B. Configuration:

1. Front: 1-1/2-inch(38-mm) laminated eased edge.
2. Backsplash: Straight, slightly eased at corner.
3. End Splash: Matching backsplash.

C. Countertops: thick, solid surface material with front edge built up with same material.

D. Countertops: 1/4-inch- (6.4-mm-) thick, solid surface material laminated to 3/4-inch- (19-mm-) thick particleboard with exposed edges built up with 3/4-inch-(19-mm-) thick, solid surface material.

E. Backsplashes: 1/2-inch-(12.7-mm-) thick, solid surface material.

F. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.

G. Joints: Fabricate countertops in sections for joining in field.

1. Joint Locations: Not within 18 inches (450 mm) of a sink or cooktop and not where a countertop section less than 36 inches (900 mm) long would result, unless unavoidable.
2. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints where indicated. Make width of cuts slightly more than thickness of splines to provide snug fit. Provide at least three splines in each joint.

H. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch (5 mm) into fixture opening.

2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

B. Sealant for Countertops: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m), 1/4 inch (6 mm) maximum. Do not exceed 1/64-inch (0.4-mm) difference between planes of adjacent units.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

C. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

1. Install metal splines in kerfs in countertop edges at joints where indicated. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

D. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

E. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.

F. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

1. Seal edges of cutouts in particleboard subtops by saturating with varnish.

G. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

END OF SECTION 12 36 61.16

MAROTTA/MAIN
ARCHITECTS

PROJECT MANUAL

VOLUME 3 OF 3 – MEP & CIVIL SPECIFICATIONS

CHANCELLOR CENTER RENOVATIONS
30 N Chancellor Street
Newtown, PA 18940

for

COUNCIL ROCK SCHOOL DISTRICT
30 N Chancellor Street
Newtown, PA 18940

BID SET
OCTOBER 13, 2026

SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Mechanical sleeve seals.
3. Sleeves.
4. Escutcheons.
5. Grout.
6. Equipment installation requirements common to equipment sections.
7. Painting and finishing.
8. Concrete bases.
9. Supports and anchorages.

B. Provide all labor, materials, equipment, and services necessary for and incidental to the complete installation and operation of all mechanical work.

C. Unless otherwise specified, all submissions shall be made to, and acceptances and approvals made by the Architect and the Engineer.

D. Contract Drawings are generally diagrammatic and all offsets, fittings, transitions and accessories are not necessarily shown. Furnish and install all such items as may be required to fit the work to the conditions encountered. Arrange piping, equipment, and other work generally as shown on the contract drawings, providing proper clearance and access. Where departures are proposed because of field conditions or other causes, prepare and submit detailed shop drawings for approval in accordance with "Submittals" specified below. The right is reserved to make reasonable changes in location of equipment, piping, and ductwork, up to the time of rough-in or fabrication.

E. Conform to the requirements of all rules, regulations and codes of local, state and federal authorities having jurisdiction.

F. Coordinate the work under Division 21 with the work of all other construction trades.

G. Be responsible for all construction means, methods, techniques, procedures, and phasing sequences used in the work. Furnish all tools, equipment and materials necessary to properly perform the work in first class, substantial, and workmanlike manner, in accordance with the full intent and meaning of the contract documents.

H. The majority of the building, including roof and attic spaces, are of wood construction. The roof and attic spaces are unheated and naturally ventilated.

I. All piping shall be concealed unless otherwise reviewed and approved by the architect and owner.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Mechanical sleeve seals.
2. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations. Coordinate the work under Division 21 with the work of all other construction trades. Conform to the requirements of all rules, regulations, and Codes of local, State and Federal Authorities Having Jurisdiction.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in this Division.

1.8 DESCRIPTION:

A. Layout sprinkler system complete and size all fire protection piping in accordance with requirements of the National Fire Protection Association, Local Fire Department and State Fire Marshal. System shall be designed for occupancy as required by applicable codes. Conceal fire protection piping in finished spaces unless indicated otherwise. System drains and inspector's test shall not be located in finished spaces.

B. Sprinkler equipment and work shall conform to requirements of National Fire Protection Association Standard NO. 13. In addition, all work shall conform to the latest requirements of all Codes and regulations of Authorities Having Jurisdiction over this work, including, but not limited to, State Fire Marshal, Local Fire Department, Safety Codes, International Building Codes and ANSI Elevator and Escalator Code.

C. Preliminary Shop Drawing: Prior to preparing detailed working drawings for submission to State Fire Marshal, submit preliminary sprinkler system layout to the Architect for review and approval. Show all finished ceilings, light fixtures, air diffusers, and other ceiling-mounted devices. Coordinate sprinkler head types and locations with ceiling types.

D. The Fire Protection Contractor shall prepare dimensioned and detailed working drawings, specification, and hydraulic calculations and submit same to the State Fire Marshal for review and approval. The Fire Protection Contractor shall have hydraulic calculations, dimensioned working drawings, and specifications signed and sealed by a registered Fire Protection Engineer prior to the submittal review process. One set of these approved documents shall be provided each, to the Engineer, Architect, and Owner for record purposes. All costs related to changes required to obtain the Fire Marshal's approval shall be the responsibility of the Contractor.

E. Manufactured equipment and materials shall be submitted to the Engineer for review and approval.

F. Provide all labor, materials, equipment, and services necessary for and incidental to the complete installation and operation of all fire protection work. Including but not limited to:
   1. Wet and dry pipe sprinkler system
   2. Fire pump, jockey pump, and controls

1.9 PERMITS AND FEES

A. Obtain all permits and pay taxes, fees, and other costs in connection with the work. File necessary plans, prepare documents, give proper notices, and obtain necessary approvals. Deliver inspection and approval certificates to Owner prior to final acceptance of the work.

B. Permits and fees shall comply with the General Requirements of the specification.

1.10 EXAMINATION OF SITE

A. Examine the site, determine all conditions and circumstances under which the work must be done, and make all necessary allowances for same. No additional cost to the Owner will be permitted for Contractor's failure to do so.

1.11 CONTRACTOR QUALIFICATION

A. Any Contractor or Subcontractor performing work under Mechanical Divisions shall be fully qualified and acceptable to the Architect. Submit the following evidence, if requested.

1. A list of not less than five comparable projects that the contractor completed.
2. Letter of reference form not less than three registered professional engineers, Contractors or building owners.
3. Local and/or State License, where required.
4. Membership in trade or professional organizations where required.

B. A Contractor is any individual, partnership, or corporation, performing work by Contract or subcontract on this project.

C. Acceptance of a Contractor of Subcontractor will not relive the contractor or subcontractor of any contractual requirements or his responsibility to supervise and coordinate the work of various trades.

1.12 MATERIALS AND EQUIPMENT:

A. Materials and equipment installed as a permanent part of the project shall be new, unless otherwise indicated or specified, and of the specified type and quality. This Contractor shall be responsible for connection all utilities as shown on the drawings to equipment identified as "under another Division".

B. Where material or equipment is identified by proprietary name, model number, and/or manufacturer, furnish named item, or its equal only of other manufacturers who are indicated in this specification, subject to approval by the Engineer, Architect and the School District. Alternate manufacturers or items other than the first-named shall be equal or better in quality and performance and must be suitable for available space, required arrangement, and application. Submit all data necessary to determine suitability of substituted items for approval.

C. The suitability of named item only has been verified. Where more than one item is named, only the first named item has been verified as suitable. Alternate manufacturers/items are items other than first named, which shall be equal or better in quality and performance to that of specified items, and must be suitable for available space, required arrangement and application. Manufacturers not named are not acceptable and shall not be submitted.

D. Substitution will not be permitted for specified items of material or equipment where only one manufacturer is identified.

E. The Contractor shall only submit those manufacturers indicated in the specification. Proposed alternate manufacturers must be approved by the Owner and be included into the specifications by Addenda.

Substitutions are for materials or manufacturers not listed in this specification. For each substitution proposed by the contractor, the contractor shall clearly indicate all differences from the specified item, change in Contract cost, benefit to the Owner, and a brief description why the substitution is being proposed. Refer to the General Conditions for additional information. The Owner shall ultimately accept/reject all substitution requests. Refer to the General Conditions of this specification for additional information.

1.13 FIRE SAFE MATERIALS

A. Unless otherwise indicated, materials and equipment shall conform to UL, NFPA, or ASTM standards for fire safety with smoke and fire hazard rating not exceeding flame spread of 25 and smoke developed of 50.

1.14 REFERENCED STANDARDS, CODES AND SPECIFICATIONS:

A. Specifications, Codes and Standards listed below are included as part of this specification, latest edition.

AABC - Associated Air Balance Council
ABMA - American Boiler Manufacturers Association
ACCA - Air Conditioning Contractors of America
ACGIH - American Conference of Governmental Industrial Hygienist
ADC - Air Diffusion Council
AIHA - American Industrial Hygiene Association
AGA - American Gas Association
AMCA - Air Movement and Control Association
ANSI - American National Standards Institute
ARI - Air Conditioning and Refrigeration Institute
ASA - Acoustical Society of America
ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME - American Society of Mechanical Engineers
ASTM - American Society for Testing and Materials
AWWA - American Water Works Association
CABO - Council of American Building Officials
CAGI - Compressed Air and Gas Institute
CS - Commercial Standard
CSA - Canadian Standards Association
CTI - Cooling Tower Institute
HEI - Heat Exchanger Institute
HI - Hydraulic Institute
HYDI - Hydronics Institute
IAPMO - International Association of Plumbing and Mechanical Officials
IBC - International Building Code
IBR - Institute of Boiler and Radiator Manufacturers
ICBO - International Conference of Building Officials
IEEE - Institute of Electrical and Electronics Engineers
IFCI - International Fire Code Institute
IMC - International Mechanical Code
IPC - International Plumbing Code
MSSP - Manufacturers Standards Society of the Valve and Fittings Industry
NEC - National Electrical Code
NEMA - National Electrical Manufacturers Association
NFPA - National Fire Protection Association
NSF Int. - National Sanitation Foundation
SMACNA - Sheet Metal and Air Conditioning Contractors National Association
TEMA - Tubular Exchanger Manufacturers Association
UL - Underwriters' Laboratories

B. All mechanical equipment and materials shall comply with the codes and standards listed in the latest ASHRAE Handbook.

1.15 SUBMITTALS, REVIEW AND ACCEPTANCE:

A. Equipment, materials, installation,workmanship and arrangement of work are subject to review and acceptance. No substitution will be permitted after acceptance of equipment or materials except where such substitution is considered by the Engineer to be in the best interest of the Owner.

B. Within 30 calendar days after award of contract, submit a complete Material and Equipment List for approval. List all proposed materials and equipment, indicating proposed manufacturer, type, class, model and other general identifying information.

C. After acceptance of Material and Equipment List, submit complete descriptive data for all items. Data shall consist of specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, wiring diagrams, installation instructions, and any other information necessary to indicate complete compliance with Contract Documents. Edit submittal data specifically for application to this project.

D. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and any electrical requirements for equipment submitted. Contractor shall be responsible for correctness of all submittals. Each piece of equipment and its associated components (e.g., relays, fuses, disconnects, etc.) shall be clearly identified.

E. Submittals will be reviewed for general compliance with design concept in accordance with contract documents, but dimensions, quantities, or other details will not be verified.

F. Identify submittals, indicating intended application, location and service of submitted items. Refer to specification sections or paragraphs where applicable. Clearly indicate exact type, model number, style, size and special features of proposed item. Submittals of a general nature will not be acceptable. For items other than first-named, clearly list on the first page of the submittal all differences between the specified item and the proposed item. The Contractor shall be responsible for corrective action (or replacement with the specified item) while maintaining the specification requirements if differences have not been clearly indicated in the submittal.

G. Submit actual operating conditions or characteristics, including NC Levels, for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable.

H. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted.

1.16 SHOP DRAWINGS:

A. Prepare and submit shop drawings for all specially fabricated items, modification to standard items, specially designed systems where detailed design is not shown on the contract drawings, or where the proposed installation differs from that shown on the Contract Drawings.

B. The Contractor, additionally, shall submit for approval any other shop drawings as required by the Architect. No item listed above shall be delivered to the site, or installed, until approved. After the proposed materials have been approved, no substitution will be permitted except where approved by the Architect.

1.17 SUPERVISION AND COORDINATION:

A. Provide complete supervision, direction, scheduling, and coordination of all work under the contract, including that of subcontractors.

B. Coordinate rough-in of all work and installation of sleeves, anchors, and supports for piping, and other work performed under Division 21.

C. Coordinate electrical work required under Division 21 with that under Division 26 and 28. Coordinate all work under Division 21 with work under all other Divisions.

1.18 CUTTING AND PATCHING

A. Accomplish all cutting and patching necessary for the installation of work under Division 21. Damage resulting from this work to other work already in place, shall be repaired at Contractor's expense. Where cutting is required, saw-cut or core drill only, and perform work in neat and workmanlike manner. Use mechanics skilled in the particular trades required.

B. Do not cut structural members without approval.

1.19 PENETRATION OF WATERPROOF CONSTRUCTION

A. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls, and interior waterproof construction. Where such penetrations are necessary, furnish all necessary curbs, sleeves, flashings, fittings and caulking to be installed by the Roofing Contractor.

B. Where vents or other pipes penetrate roofs, flash pipe with All American, Inc., or approved equal, roof flashing assemblies, with 6-inch skirt, cap, and caulked counter-flashing sleeves.

C. Pitch pockets are prohibited.

D. Furnish and install roof drains, curbs, vent assemblies, and duct sleeves specifically designed for application to the particular roof construction, and install in accordance with the manufacturer's instructions. The National Roofing Contractors Association, SMACNA and as required by other Divisions to this specification. The Contractor shall be responsible for sleeve sizes and locations.

1.20 ACCESSIBILITY

A. All equipment shall be installed in such a way that all components requiring access (such as valves, flow switches, tamper switches, site glasses, disconnect switches, circuit breakers, starters, and accessories) are so located and installed that they may be serviced, reset, replaced, recalibrated, etc., by service technicians in accordance with the Manufacturer's recommendations. If any equipment or components are located in such a position that this Contractor cannot comply with the above, the Contractor shall notify the Engineer in writing before equipment is installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 21 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, galvanized steel, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Galvanized Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

B. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

C. Galvanized Steel Sheet Sleeves: Minimum thickness 0.0239”; round tube closed with welded longitudinal joint.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:
    a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    c. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.

M. Sleeves are required for core-drilled holes.

N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.
    a. Exception: Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    a. Galvanized Steel Pipe Sleeves: For pipes through walls and floors except where noted through membrane waterproofing.
    b. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing. Seal space outside of sleeve fittings with grout.
    c. Provide galvanized steel sheet sleeves for interior stud partitions.
    d. Provide galvanized steel wall sleeves with sleeve seal system for walls below grade and concrete slabs on grade. Select sleeve size to allow one-inch annular clear space between piping and sleeve for installing sleeve seal system. Select type, size and number of sealing elements required for piping material and size for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve system components and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a water-tight seal.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

S. Based on limited infrastructure space the sprinkler system shall be carefully and fully coordinated with all other trades including finishes, support requirements, etc.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1 for piping 2-1/2" and less. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Mechanical Joints: Use for piping 3" and larger; shall be rolled groove pipe.

3.3 PAINTING

A. Painting of fire-suppression systems, equipment, and components is specified in this Division Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

C. Provide protective finishes on all materials and equipment. Use coated or corrosion-resistant materials, hardware and fittings throughout the work. Paint bare, untreated ferrous surfaces with rust-inhibiting paint. All exterior components including supports, hangers, nuts, bolts, washers, vibration isolators, etc., shall be galvanized or stainless steel.

D. Clean surfaces prior to application of insulation, adhesives, coatings, paint, or other finishes.

E. Provide factory-applied finishes where specified. Unless otherwise indicated factory-applied paints shall be baked enamel with proper pretreatment.

F. Protect all finishes and restore any finishes damaged to their original condition.

G. The preceding requirements apply to all work, whether exposed or concealed.

H. Remove all construction marking and writing from exposed equipment, piping and building surfaces. Do not paint manufacturer's labels or tags.

I. All exposed piping, equipment, etc. shall be painted under Division 21 unless noted otherwise. Colors shall be selected by the Architect and conform to ANSI Standards.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.5 GROUTING

A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.6 SUPPORTS, HANGERS, AND FOUNDATIONS

A. Provide supports, hangers, braces, attachments and foundations required for the work. Support and set the work in a thoroughly substantial and workmanlike manner without placing strains on materials, equipment, or building structure, submit shop drawings for approval. Coordinate all work with the requirements of the structural division. Note the majority of the building is wood construction.

B. Supports, hangers, braces, and attachments shall be standard manufactured items or fabricated structural steel shapes. All interior hangers shall be galvanized or steel with rust inhibiting paint. For uninsulated copper piping/tubing provide copper hanger with wool or felt insert to prevent contact of dissimilar metals. All exterior hangers shall be constructed of galvanized steel or stainless steel utilizing stainless steel rods, nuts, washers, bolts, etc.

C. Provide concrete pads and foundations for equipment. Concrete housekeeping pads and foundations shall be not less than 4 inches high and shall extend a minimum of 3 inches beyond equipment bases. Provide wire-mesh or re-bar reinforcement; chamfer exposed edges and corners; and finish exposed surfaces smooth.

3.7 PROVISIONS FOR ACCESS:

A. The Contractor shall provide access panels and doors for all concealed equipment, valves, strainers, controls, control devices, cleanouts, traps, and other devices requiring maintenance, service, adjustment, balancing or manual operation.

B. Where access doors are necessary, furnish and install manufactured steel door assemblies consisting of hinged door, cylinder locks (keyed alike) **,** and frame designed for the particular wall or ceiling construction. Properly locate each door. Door size shall be a minimum of 24" x 24" unless otherwise approved by the Architect/Engineer. Provide UL Approved and labeled access doors where installed in fire rated walls or ceilings. Doors shall be Milcor Metal Access Doors as manufactured by Inland-Ryerson, or approved equal.

1. Acoustical or Cement Plaster: Style B
2. Hard Finish Plaster: Style K or L
3. Masonry or Dry Wall: Style M

C. Where access is by means of lift-out ceiling tiles or panels, mark each panel using small color-coded or numbered tabs. Provide a chart or index for identification. Charts shall be similar to valve charts specified

hereinafter. Provide chart in O & M Manual and in the Main Mechanical Equipment Room. Screw markers shall be mounted on the ceiling grid.

D. Access panels, doors, etc., described herein shall be furnished under the section of specifications providing the particular service to be turned over to the pertinent trade for installation. Coordinate installation with installing Contractor. Coordinate locations with the Architect prior to installation.

E. Label access doors as required by NFPA requirements.

3.8 PROTECTION OF WORK:

A. Protect work, material and equipment from weather and construction operations before and after installation. Properly store and handle all materials and equipment.

B. Cover temporary openings in piping and equipment to prevent the entrance of water, dirt, debris, or other foreign matter.

C. Cover or protect all finishes.

D. Replace damaged materials, devices, finishes, and equipment.

3.9 OPERATION OF EQUIPMENT:

A. Clean all systems and equipment prior to initial operation for testing or other purposes. Lubricate, adjust, and test all equipment in accordance with manufacturer's instructions. Do not operate equipment unless all proper safety devices or controls are operational. Provide all maintenance and service for equipment that is authorized for operation during construction.

B. Provide the services of the manufacturer's factory-trained servicemen or technicians to start up the equipment.

C. Do not use fire protection systems for temporary services during construction.

D. Upon completion of work, clean and restore all equipment to new conditions; blowdown all strainers, etc.

3.10 RECORD DRAWINGS:

A. Upon completion of the mechanical installations, the Contractor shall deliver to the Architect one complete set of mylars of the mechanical contract drawings which shall be legibly marked in red pencil to show all changes and departures of the installation as compared with the original design. Provide a color scan of record drawings and provide in electronic format on an external hard drive. They shall be suitable for use in preparation of Record Drawings.

3.11 GUARANTEE:

A. Contractor's attention is directed to guarantee obligations contained in the GENERAL CONDITIONS.

B. The above shall not in any way void or abrogate equipment manufacturer's guarantee or warranty. Certificates of guarantee shall be included in the operations and maintenance manuals.

C. Contractor shall provide two (2) years full factory warranty on parts and labor for all equipment from the time of final acceptance of the mechanical systems by the Owner. Warranty shall include 24-hour service. This service shall be rendered upon request when notified of any equipment malfunctions.

D. The guarantee shall not start until substantial completion of the project.

3.12 LUBRICATION:

A. All bearings, motors, and all equipment requiring lubrication shall be provided with accessible fittings for same. Before turning over the equipment to the Owner, the Contractor shall fully lubricate each item of equipment, shall provide one year's supply of lubricant for each, and shall provide Owner with complete written lubricating instructions, together with diagram locating the points requiring lubrication. Include this information in the Record and Information Booklet.

B. In general, all motors and equipment shall be provided with grease lubricated roller or ball bearings with Alemite or equal accessible or extended grease fittings and drain plugs.

C. Provide remote grease fittings with copper lube lines for pumps and for bearings/motors where grease fittings are situated in locations inconvenient/inaccessible for lubrication.

D. Provide pressure relief fittings at all grease lubrication locations designed to automatically vent within the range of 1/4 to 1 psi, automatically reset below this range, or another pressure relief range if the preceding differs from the manufacturer’s recommended pressure range.

3.13 RECORD AND INFORMATION BOOKLET:

A. The Contractor shall have prepared three (3) copies of the Record and Information Booklet and deliver these copies of the booklet to the Owner. The booklet shall be as specified herein. The booklet must be approved and will not be accepted as final until so stamped.

B. The booklet shall be bound in a three-ring loose-leaf binder similar to "National" No. 3881 with the following title lettered on the front: "Record and Information Booklet (insert name of the project)". No sheets larger than 8-1/2" x 11" shall be used, except sheets that may be neatly folded to 8-1/2" x 11" and used as a pull-out.

C. All booklet information shall also be provided in electronic format, PDF files, stored on an external hard drive. Each binder shall contain an envelope sleeve containing the electronic format media.

D. Provide the following data in the booklet:

1. Catalog data on each piece of fire protection equipment furnished.
2. Maintenance operation and lubrication instruction son each piece of equipment furnished.
3. Complete catalog data on each piece of fire protection equipment furnished, including approved shop drawings.
4. Manufacturer’s and Contractors’ guarantees.
5. Chart form indicating time and type of routine maintenance of the fire protection system and/or equipment. The chart shall also indicate tag number, model number of equipment, location and service. For replacement items such as filters, indicate type, size and quantity of the replaceable items.
6. Provide sales and service representatives’ names and phone numbers of all equipment and subcontractors.
7. Catalog data of all equipment, valves, etc., which shall include wiring diagrams, parts list and assembly drawing.
8. Provide valve chart including valve tag number, valve type, valve model number, valve manufacturer, style, service and location, etc., as specified hereinafter.
9. Provide copies of all start-up reports.
10. Provide certification that lead-free and asbestos-free products were provided.
11. Provide operating curves indicating design and balanced conditions for pumps.
12. Provide copies of all flushing reports.
13. External hard drive of all demonstration and instruction periods.

14. External hard drive of all coordination and/or fire protection drawings.

3.14 WIRING DIAGRAMS

A. Obtain and submit wiring diagrams for all equipment provided under this Contract.

B. Wiring diagrams shall be provided with Shop Drawings for similar to, but not limited to, all equipment.

C. The Contractor shall submit any additional wiring diagrams as requested by the Engineer.

D. Provide wiring diagrams and identify all termination points, connections and interface points for all major mechanical equipment to the Electrical Contractor and the ATC Subcontractor for coordination.

3.15 INSTALLATION AND COORDINATION DRAWINGS

A. Prepare, submit, and use composite installation and coordination drawings to assure proper coordination and installation of work. Drawings shall include, but not be limited, to the following: Complete Ductwork, Plumbing, Sprinkler and HVAC Piping Drawings showing coordination with approved equipment, approved casework drawings, lights, electrical equipment and structural. The Mechanical Contractor is responsible for coordinating with all trades to insure systems will fit in the available space. If conflicts exist after fabrication and/or installation of systems prior to preparing a coordinated drawing of the area, the Contractor shall remove, re-fabricate, and re-install all such work at their own cost, except for the difference in cost, if any, from the originally designed system to the revised design. If no design changes were made, and clarifications were required, it shall be at no expense to the Owner. Division 23 shall coordinate development of composite coordination drawings.

B. Draw plans to a scale not less than 3/8-inch equals one foot. Include plans, sections, and elevations of proposed work, showing all equipment, piping and ductwork in areas involved. Fully dimension all work including fume hoods, casework and associated utilities, valve boxes, lighting fixtures, conduits, pullboxes, panelboards, and other electrical work, telecommunications equipment, walls, doors, ceilings, columns, beams, joists and other architectural and structural work.

C. Identify all equipment and devices on wiring diagrams and schematics. Where field connections are shown to factory-wired terminals, include manufacturer's literature showing internal wiring.

D. All coordination drawings shall be prepared in AutoCAD or Revit format and submitted in color. Different colors shall be used to determine different building components. In addition to the composite coordination drawings, simultaneously submit individual sheet-metal, piping, and sprinkler coordination drawings.

E. Prepare separate coordinated reflected ceiling plans in 1/8”, 1/4”, or 3/8” scale showing grid systems, lighting fixtures, communication system components, TV brackets, sprinkler heads, air devices, and all other ceiling-mounted items.

F. The Mechanical Contractor shall schedule bi-weekly Coordination Drawing Reviews with the Owner, Mechanical Engineer, and all associated subcontractors, including but not limited to the following:

1. Mechanical Contractor
2. Finishes Contractor
3. Sheet Metal Contractor
4. Sprinkler Contractor
5. Electrical Contractor
6. Plumbing Contractor
7. Owner/Architect/Engineer/Construction manager
8. Note: A Foreman or Project Manager responsible for Decision-Making of each company shall attend all Coordination Meetings.

G. The purpose of these meetings is to coordinate proposed installations of systems and equipment, including clearances, routing, penetrations, as well as to review potential conflicts. The Mechanical Contractor shall base preliminary equipment sizes and connections on proposed products and the final coordination drawing for review shall reflect approved/reviewed products. Coordination Meetings shall be held at the Contractor's Field Office.

3.16 FACTORY START-UP:

A. Provide factory authorized start-up service for all fire protection equipment.

B. Provide one copy of all start-up reports to the Owner and include a copy in the O&M Manual.

3.17 MECHANICAL INSTALLATIONS:

A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment including, but not limited to, the following:

1. Coordinate mechanical systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed, noted, or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished space.
10. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of equipment components in accordance with manufacturers' recommendations. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
11. Install access panels or doors where units are concealed behind finished surfaces.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
13. Install above-ceiling equipment requiring servicing and/or maintenance within 48" of accessible ceilings/access panels.

END OF SECTION

SECTION 21 05 23 - GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Two-piece ball valves with indicators.
2. Bronze butterfly valves with indicators.
3. Iron butterfly valves with indicators.
4. Check valves.
5. Bronze OS&Y gate valves.
6. Iron OS&Y gate valves.
7. NRS gate valves.
8. Indicator posts.
9. Trim and drain valves.

1.3 DEFINITIONS

A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

B. NRS: Nonrising stem.

C. OS&Y: Outside screw and yoke.

D. SBR: Styrene-butadiene rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and weld ends.
3. Set valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

D. Protect flanges and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:

1. Main Level: HAMV - Fire Main Equipment.

a. Level 1: HCBZ - Indicator Posts, Gate Valve.
b. Level 1: HLOT - Valves.
1) Level 3: HLUG - Ball Valves, System Control.
2) Level 3: HLXS - Butterfly Valves.
3) Level 3: HMER - Check Valves.
4) Level 3: HMRZ - Gate Valves.

2. Main Level: VDGT - Sprinkler System & Water Spray System Devices.

a. Level 1: VQGU - Valves, Trim and Drain.

B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:

1. Automated Sprinkler Systems:

a. Indicator posts.
b. Valves.
1) Gate valves.
2) Check valves.
a) Single check valves.

3) Miscellaneous valves.

C. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.

D. ASME Compliance:

1. ASME B16.1 for flanges on iron valves.
2. ASME B1.20.1 for threads for threaded-end valves.
3. ASME B31.9 for building services piping valves.

E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

F. NFPA Compliance: Comply with NFPA 24 for valves.

G. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as required by system pressures.

H. Valve Sizes: Same as upstream piping unless otherwise indicated.

I. Valve Actuator Types:

1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
2. Handwheel: For other than quarter-turn trim and drain valves.
3. Handlever: For quarter-turn trim and drain valves NPS 2 (DN 50) and smaller.

2.2 TWO-PIECE BALL VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide Victaulic company or as approved equal.

C. Description:

1. UL 1091, except with ball instead of disc and FM Global standard for indicating valves (butterfly or ball type), Class Number 1112.
2. Minimum Pressure Rating: 175 psig (1200 kPa).
3. Body Design: Two piece.
4. Body Material: Forged brass or bronze.
5. Port Size: Full or standard.
6. Seats: PTFE.
7. Stem: stainless steel.
8. Ball: Stainless steel
9. Actuator: Worm gear or traveling nut.
10. Supervisory Switch: Internal or external.
11. End Connections for Valves NPS 1 (DN 25) through NPS 2 (DN 50): Threaded ends.
12. End Connections for Valves NPS 2-1/2 (DN 65): Grooved ends.

2.3 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
   a. Standard-Pressure Piping Specialty Valves: 175 psig (1200 kPa) minimum.
   b. High-Pressure Piping Specialty Valves: 250 psig (1725 kPa) minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Dry-Pipe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AFAC Inc.
   b. Globe Fire Sprinkler Corporation.
   c. Reliable Automatic Sprinkler Co., Inc.
   d. Tyco Fire & Building Products LP.
   e. Venus Fire Protection Ltd.
   f. Victaulic Company.
   g. Viking Corporation.
2. Standard: UL 260
3. Design: Differential-pressure type.
4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
5. Air-Pressure Maintenance Device:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) AFAC Inc.
      2) Globe Fire Sprinkler Corporation.
      3) Reliable Automatic Sprinkler Co., Inc.

4) Tyco Fire & Building Products LP.
5) Venus Fire Protection Ltd.
6) Victaulic Company.
7) Viking Corporation.

b. Standard: UL 260.
c. Type: Automatic device to maintain minimum air pressure in piping.
d. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range, and 175-psig (1200-kPa) outlet pressure.

6. Air Compressor:

a. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1) General Air Products, Inc,
2) Viking Corporation.

b. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
c. Motor Horsepower: Fractional.
d. Power: 120-V ac, 60 Hz, single phase.

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. AFAC Inc.
b. Reliable Automatic Sprinkler Co., Inc.
c. Tyco Fire & Building Products LP.

2. Standard: UL 1726.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4 (DN 20).
6. End Connections: Threaded.

2.4 SPRINKLER SPECIALTY PIPE FITTINGS

A. General Requirements for Dry-Pipe-System Fittings: UL listed for dry-pipe service.

B. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.
b. National Fittings, Inc.
c. Shurjoint Piping Products.
d. Tyco Fire & Building Products LP.
e. Victaulic Company.

2. Standard: UL 213.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

C. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. AGF Manufacturing Inc.
    b. Reliable Automatic Sprinkler Co., Inc.
    c. Tyco Fire & Building Products LP.
    d. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

D. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Elkhart Brass Mfg. Company, Inc.
    b. Fire-End & Croker Corporation.
    c. Potter Roemer.
2. Standard: UL 199.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

E. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. AGF Manufacturing Inc.
    b. Triple R Specialty.
    c. Tyco Fire & Building Products LP.
    d. Victaulic Company.
    e. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

F. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. CECA, LLC.
    b. Corcoran Piping System Co.
    c. Merit Manufacturing; a division of Anvil International, Inc.
2. Standard: UL 1474.
3. Pressure Rating: 250 psig (1725 kPa) minimum.
4. Body Material: Steel pipe with EPDM O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

A. Comply with requirements in the following Sections for specific valve installation requirements and applications:

1. Section 211313 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.
2. Section 211316 "Dry-Pipe Sprinkler Systems" for application of valves in dry-pipe, fire-suppression sprinkler systems.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above the pipe center.

F. Install valves in position to allow full stem movement.

G. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

H. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections.

I. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

END OF SECTION

SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal hanger-shield inserts.
5. Fastener systems.
6. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Equipment supports.

C. Delegated-Design Submittal: For hangers to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for fire-suppression piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. NFPA Compliance: Comply with NFPA 13.

D. UL Compliance: Comply with UL 203.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
2. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

B. Copper Pipe and Tube Hangers:

1. Description: Copper-coated-steel, factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with NFPA-approved, UL-listed, or FM-approved carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
3. Channels: Continuous slotted coated carbon-steel channel with inturned lips.
4. Channel Width: Selected for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
7. Metallic Coating: Pregalvanized G90 (Z275), Electroplated zinc or Hot-dip galvanized.
8. Paint Coating: Green epoxy, acrylic, or urethane.

2.5 THERMAL HANGER-SHIELD INSERTS

A. Insulation-Insert Material: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-psi (688-kPa) ASTM C552, Type II cellular glass with 100-psi (688-kPa) or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psi (862-kPa) minimum compressive strength.

B. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

C. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

D. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: NFPA-approved, UL-listed, or FM-approved threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: NFPA-approved, UL-listed, or FM-approved, insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Indoor Applications: Zinc-coated or Stainless steel.

2. Outdoor Applications: Stainless steel.

2.7 EQUIPMENT SUPPORTS

A. Description: NFPA-approved, UL-listed, or FM-approved, welded, shop- or field-fabricated equipment support, made from structural-carbon-steel shapes.

2.8 MATERIALS

A. Aluminum: ASTM B221 (ASTM B221M).

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout, suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

3.2 INSTALLATION OF HANGERS AND SUPPORTS

A. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal strut systems.

D. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

E. The building is primarily wood construction. Hangers and supports shall be designed, furnished, and installed to conceal piping above ceiling systems, clouds, etc. including between wood joist.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:

1. Attach clamps and spacers to piping.

   a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. MSS SP-58, Type 39 Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

   a. MSS SP-58, Type 40 Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
   b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
   c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
   d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
   e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.

5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

N. Do not use powder actuated fastener systems.

3.3 INSTALLATION OF EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.6 PAINTING

A. Touchup:

1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

2. Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099113 "Exterior Painting and Section 099123 "Interior Painting."

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications, pipe vaults and exterior applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use thermal hanger-shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Comply with NFPA requirements.

L. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. C-Clamps (MSS Type 23): For structural shapes.
3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

M. Saddles and Shields: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

N. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction. This method shall be reviewed and approved (in writing) for use by the architect, structural engineer, and owner.

END OF SECTION 21 05 29

SECTION 21 05 48 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Pipe-riser resilient supports.
5. Resilient pipe guides.
6. Elastomeric hangers.

B. Related Requirements:

1. Section 220548 "Vibration Controls for Plumbing Piping and Equipment" for devices for plumbing equipment and systems.
2. Section 230548 "Vibration Controls for HVAC" for devices for HVAC equipment and systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.

B. Delegated-Design Submittal: For each vibration isolation device.

1. Include design calculations for selecting vibration isolators.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation for fire-suppression piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For testing agency.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
2. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc. or comparable product by one of the following:

   a. Ace Mountings Co., Inc.
   b. California Dynamics Corporation.
   c. Isolation Technology, Inc.
   d. Kinetics Noise Control, Inc.
   e. Vibration Eliminator Co., Inc.
   f. Vibration Isolation.
   g. Vibration Mountings & Controls, Inc.

3. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
4. Size: Factory or field cut to match requirements of supported equipment.
5. Pad Material: Oil and water resistant with elastomeric properties.
6. Surface Pattern: Waffle pattern.
7. Infused nonwoven cotton or synthetic fibers.
8. Load-bearing metal plates adhered to pads.
9. Sandwich-Core Material: Resilient and elastomeric <Insert compound>.

   a. Surface Pattern: Smooth Ribbed Waffle pattern.
   b. Infused nonwoven cotton or synthetic fibers.

2.2 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings Mason Industries, Inc. or comparable product by one of the following:

   a. Ace Mountings Co., Inc.
   b. California Dynamics Corporation.
   c. Isolation Technology, Inc.
   d. Kinetics Noise Control, Inc.
   e. Vibration Eliminator Co., Inc.
   f. Vibration Isolation.
   g. Vibration Mountings & Controls, Inc.

3. Mounting Plates:

   a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
   b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

4. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.3 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
2. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc. or comparable product by one of the following:

   a. Ace Mountings Co., Inc.
   b. California Dynamics Corporation.
   c. Isolation Technology, Inc.
   d. Kinetics Noise Control, Inc.
   e. Vibration Eliminator Co., Inc.
   f. Vibration Isolation.
   g. Vibration Mountings & Controls, Inc.

3. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

   a. Housing: Cast-ductile iron or welded steel.
   b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 PIPE-RISER RESILIENT SUPPORTS

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- (13-mm-) thick neoprene.

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
2. Maximum Load Per Support: 500 psig (3.45 MPa)on isolation material providing equal isolation in all directions.

2.5 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- (13-mm-) thick neoprene.

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.6 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
2. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc. or comparable product by one of the following:

   a. Ace Mountings Co., Inc.
   b. California Dynamics Corporation.
   c. Isolation Technology, Inc.
   d. Kinetics Noise Control, Inc.
   e. Vibration Eliminator Co., Inc.
   f. Vibration Mountings & Controls, Inc.

3. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.

4. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION CONTROL DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

END OF SECTION

SECTION 21 05 53 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number based on the school district's PM Identification System.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions. Label per the school district standards.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive for pipe sizes four-inches and less. For larger pipe sizes (six-inches and greater), markers shall be strapped around using nylon ties.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME (ANSI) A13.1 for piping; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Fiberboard or metal.
2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel in colors according to ASME (ANSI) A13.1 unless otherwise indicated.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) black-filled letters for piping system abbreviation and 1/2-inch (13-mm) black-filled numbers, 2-inch diameter.

1. Tag Material: Brass, 19 gauge minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass jack chain.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches (100 by 178 mm).
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09.

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME (ANSI) A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 25 feet along each run. Reduce intervals to 15 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
8. Where pipes are adjacent to each other, markings shall be neatly lined up. All markings shall be located in such a manner to be easily legible from the floor.
9. For piping less than 3/4 inch, provide permanently legible tag as specified hereinbefore for valve identification.
10. For buried piping, provide 2-inch minimum width with plastic identification/detection tape with metallic core. Install 4 to 6-inches below-grade.

D. Pipe Label Color Schedule:

1. Sprinkler Piping:

a. Background Color: Red.
b. Letter Color: White.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units, etc. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Sprinkler Piping: 2 inches (50 mm), round.

2. Valve-Tag Color:

a. Sprinkler Piping: Red.

3. Letter Color:

a. Sprinkler Piping: White.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 21 11 00 - FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes fire-suppression water-service piping and related components outside the building from the pump building to the main building including the service entrance piping through floor into the building(s):

1. Pipes, fittings, and specialties.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of NFPA.
2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with FM Global's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.

2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end.

B. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

1. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Flanges: ASME B16.1, Class 125, cast iron.

2.2 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Material: Linear low-density PE film of 0.008-inch (0.20-mm) minimum thickness or high-density, cross-laminated PE film of 0.004-inch (0.10-mm) minimum thickness.

C. Form: Sheet or tube.

D. Color: Black or natural.

2.3 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Cascade Waterworks Manufacturing.
    b. Dresser, Inc.; Dresser Piping Specialties.
    c. Ford Meter Box Company, Inc. (The); Pipe Products Division.
    d. JCM Industries.
    e. ROMAC Industries Inc.
    f. Smith-Blair, Inc.; a Sensus company.
    g. Viking Johnson.
2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners, and with ends of same sizes as piping to be joined.
3. Standard: AWWA C219.
4. Center-Sleeve Material: Carbon steel or Ductile iron.
5. Gasket Material: Natural or synthetic rubber.
6. Pressure Rating: 150 psig (1035 kPa) 200 psig (1380 kPa) <Insert value> minimum.
7. Metal Component Finish: Corrosion-resistant coating or material.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with excavating, trenching, and backfilling requirements in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Comply with NFPA 24 for fire-service-main piping materials and installation.
    1. Install encasement for tubing according to ASTM A 674 or AWWA C105.

B. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
    1. Install encasement for piping according to ASTM A 674 or AWWA C105.

C. Bury piping with depth of cover over top at least 48 inches with top at least 12 inches (300 mm) below level of maximum frost penetration, and according to the following:
    1. Under Driveways: With at least 48 inches of cover over top.

D. Extend fire-suppression water-service piping from the underground tank/fire pump and connect to building fire-suppression water-service piping systems at locations and pipe sizes indicated.
    1. Terminate fire-suppression water-service piping within the building at the floor slab until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building's fire-suppression water-service piping systems when those systems are installed.

E. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

F. Comply with requirements in Section 211313 "Wet-Pipe Sprinkler Systems," and Section 211316 "Dry-Pipe Sprinkler Systems" for fire-suppression-water piping inside the building.

G. Install sleeves for piping penetrations of walls, ceilings, and floors.

H. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210500.

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in tubing NPS 2 (DN 50) and smaller.

C. Install flanges, flange adaptors, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.

D. Ream ends of tubes and remove burrs.

E. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.

F. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.

G. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.

H. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

I. Do not use flanges or unions for underground piping.

3.4 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.
2. Locking mechanical joints.
3. Set-screw mechanical retainer glands.
4. Bolted flanged joints.
5. Heat-fused joints.
6. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches in fire-suppression water-service piping according to NFPA 24 and the following:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.5 FIELD QUALITY CONTROL

A. Use test procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described below.

B. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

C. Hydrostatic Tests: Test at not less than one-and-one-half times the working pressure for two hours.

1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to zero psig (zero kPa). Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

D. Prepare test and inspection reports.

3.6 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground fire-suppression water-service piping. Locate below finished grade, directly over piping.

B. Permanently attach equipment nameplate or marker indicating plastic fire-suppression water-service piping or fire-suppression water-service piping with electrically insulated fittings, on main electrical meter panel. Comply with requirements for identifying devices in Section 220553 "Identification for Plumbing Piping and Equipment."

3.7 CLEANING

A. Clean and disinfect fire-suppression water-service piping as follows:

1. Purge new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

    a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow it to stand for 24 hours.
    b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow it to stand for three hours.
    c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

3.8 PIPING SCHEDULE

A. Underground fire-suppression water-service piping shall be the following:

1. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile- or gray-iron, standard-pattern fittings; glands, gaskets, and bolts; and gasketed joints.

END OF SECTION

SECTION 21 11 19 - FIRE-DEPARTMENT CONNECTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Flush-type fire-department connections.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each fire-department connection.

PART 2 - PRODUCTS

2.1 FLUSH-TYPE FIRE-DEPARTMENT CONNECTION AND PUMP TEST HEADER

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide Potter Roemer or comparable product by one of the following:

1. American Fire Hose & Cabinet.
2. Elkhart Brass Mfg. Company, Inc.
3. GMR International Equipment Corporation.
4. Guardian Fire Equipment, Inc.

C. Standard: UL 405.

D. Type: Flush, for wall mounting.

E. Pressure Rating: 175 psig (1200 kPa) minimum.

F. Body Material: Brass or bronze

G. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Verify with the local fire department prior to ordering materials. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.

H. Caps: Brass, lugged type, with gasket and chain.

I. Escutcheon Plate: Rectangular, brass, wall type.

J. Outlet: With pipe threads.

K. Body Style: Horizontal.

L. Number of Inlets: Two.

M. Outlet Location: Back.

N. Escutcheon Plate Marking: Similar to "AUTO SPKR" and “Pump Test Connection”

O. Finish: Polished Brass.

P. Outlet Size: NPS 4 (DN 100).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fire-department connections.

B. Examine roughing-in for fire-suppression standpipe system to verify actual locations of piping connections before fire-department connection installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-type fire-department and pump test connections.

B. Install automatic (ball-drip) drain valve at each check valve for fire-department connection.

END OF SECTION

SECTION 21 13 13 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Sprinklers.
3. Alarm devices.
4. Pressure gages.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig (1200 kPa) maximum.

1.4 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if required.

1.5 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.

B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional fire protection engineer, using performance requirements and design criteria indicated.

C. Sprinkler system design shall be stamped and signed by a registered fire protection engineer and approved by local fire marshal.

1. Minimum Density for Automatic-Sprinkler Piping Design:

   a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. (4.1 mm/min. over 139-sq. m) area.
   b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. (6.1 mm/min. over 139-sq. m) area.

2. Maximum Protection Area per Sprinkler: Per UL listing.
3. Maximum Protection Area per Sprinkler:

   a. Office Spaces: 120 sq. ft. (11.1 sq. m).
   b. Storage Areas: 130 sq. ft. (12.1 sq. m).

c. Mechanical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
d. Electrical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

4. Total Combined Hose-Stream Demand Requirement: According to NFPA 13.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, calculations, and attachments to other work. All detailed working drawings and associated hydraulic calculations shall be signed and sealed by a registered fire protection engineer prior to the submittal review process. The fire protection contractor shall prepare dimensioned and detailed working drawings and calculations and submit to the State or Local Fire Marshal for review and approval. Refer to Section 210500 for additional information.

C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

E. Provide samples of custom finish sprinkler head cover plates to architect for review.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a registered fire protection engineer.

B. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."

1.8 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by

NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

2. Coordinate mounting location with Owner.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes. All pipe and fittings shall meet the requirements of NFPA 13. Pipe sizes 2 ½" and less shall be threaded. Pipe sizes 3" and larger shall utilize roll grooves with mechanical couplings.

2.2 STEEL PIPE AND FITTINGS

A. Schedule 40, Galvanized- and Black-Steel Pipe: ASTM A 53; ASTM A 53M, Type E; Grade B; with wall thickness not less than Schedule 40. Pipe ends may be factory or field formed to match joining method. Cut groove ends are prohibited.

B. Malleable- or Ductile-Iron Unions: UL 860.

C. Cast-Iron Flanges: ASME 16.1, Class 125.

D. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

E. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

F. Roll-Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.
b. Corcoran Piping System Co.
c. Tyco Fire & Building Products LP.
d. Victaulic Company.

2. Pressure Rating: 175 psig (1200 kPa) minimum.
3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

G. Steel pipe nipples: Galvanized or black steel, ASTM A 733 made of ASTM A53/A53M standard weight, seamless steel pipe with threaded ends.

2.3 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire & Building Products LP.
3. Viking Corporation.
4. Victaulic.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig (1200 kPa) minimum.
3. Provide extended escutcheons in rooms with surface-mounted lighting fixtures.
4. Provide freezeproof heads for loading docks, freezers, etc., where freezing conditions exist.
5. Additional heads shall be furnished as required by NFPA 13. The heads shall be in a cabinet designed to hold the heads and include one sprinkler head wrench for each type of sprinkler. Cabinet shall be mounted where indicated in the field. Coordinate location with Owner.
6. Provide flat plate concealed pendant type sprinkler heads for ceilings.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Non-residential applications: UL 199.
3. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. White/Painted.
2. Cover plates to match proposed ceiling color and finishes (i.e. wood)

E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Painted steel, one piece, flat to match ceiling and/or wall color and finishes (i.e. wood)
2. Sidewall Mounting: Painted plated steel, one piece, flat to match ceiling and/or wall color and finishes (i.e. wood)

F. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.
   c. Viking Corporation.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.4 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections. Approved water flow switches shall be installed to activate the fire alarm system. All valves controlling water supply for sprinklers shall be electrically supervised in accordance with requirements of NFPA 13 and NFPA 72. Coordinate requirements with Division 28.

B. Water-Motor-Operated Alarm:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Globe Fire Sprinkler Corporation.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.
2. Standard: UL 753.
3. Type: Mechanically operated, with Pelton wheel.
4. Alarm Gong: Cast aluminum with red-enamel factory finish.
5. Size: 10-inch (250-mm) diameter.

6. Components: Shaft length, bearings, and sleeve to suit wall construction.
7. Inlet: NPS 3/4 (DN 20).
8. Outlet: NPS 1 (DN 25) drain connection.

C. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ADT Security Services, Inc.
   b. McDonnell & Miller; ITT Industries.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company.
   e. Viking Corporation.
   f. Watts Industries (Canada) Inc.
2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig (1725 kPa).
7. Design Installation: Horizontal or vertical.

D. Pressure Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Barksdale, Inc.
   b. Detroit Switch, Inc.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company.
   e. Tyco Fire & Building Products LP.
   f. United Electric Controls Co.
   g. Viking Corporation.
2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

E. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fire-Lite Alarms, Inc.; a Honeywell company.
   b. Kennedy Valve; a division of McWane, Inc.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

2.5 PRESSURE GAUGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AMETEK; U.S. Gauge Division.
2. Ashcroft, Inc.

3. Brecco Corporation.
4. WIKA Instrument Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.

D. Pressure Gauge Range: 0 to 250 psig (0 to 1725 kPa) minimum.

E. Water System Piping Gauge: Include "WATER" label on dial face.

2.6 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
   a. Standard-Pressure Piping Specialty Valves: 175 psig (1200 kPa) minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Globe Fire Sprinkler Corporation.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.
   e. Viking Corporation.
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber**,** and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4 (DN 20).
6. End Connections: Threaded.

2.7 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.
b. National Fittings, Inc.
c. Shurjoint Piping Products.
d. Tyco Fire & Building Products LP.
e. Victaulic Company.

2. Standard: UL 213.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AGF Manufacturing Inc.
b. Reliable Automatic Sprinkler Co., Inc.
c. Tyco Fire & Building Products LP.
d. Victaulic Company.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

C. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Elkhart Brass Mfg. Company, Inc.
b. Fire-End & Croker Corporation.
c. Potter Roemer.

2. Standard: UL 199.
3. Pressure Rating: 175 psig (1200 kPa).
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AGF Manufacturing Inc.
b. Triple R Specialty.
c. Tyco Fire & Building Products LP.
d. Victaulic Company.
e. Viking Corporation.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare calculations based on a gravity water tank with fire pump in accordance with NFPA requirements. Use results for system design calculations required in "Quality Assurance" Article.

3.2 SERVICE-ENTRANCE PIPING

A. Install shutoff valve, pressure gauge, drain, and other accessories indicated at connection to water-service piping.

B. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 WATER-SUPPLY CONNECTIONS

A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Division 22 Section "Domestic Water Piping."

B. Install shutoff valve, pressure gauge, drain, and other accessories indicated at connection to water-distribution piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.4 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 ½" (DN 65) and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 3 (DN 80) and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage. Means of drainage shall be provided with adequate protection from freezing. Drain valve may be combined with sprinkler alarm test valve and site glass. Valve shall be UL listed with positive positioning handle for OFF, TEST or DRAIN, integral site glass, orifice size equal to smallest sprinkler orifice and full one-inch drain.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

J. Install alarm devices in piping systems.

K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

L. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

M. Fill sprinkler system piping with water.

N. Install sleeves for piping penetrations of walls, ceilings, and floors.

O. Install sleeve seals for piping penetrations of concrete walls and slabs.

P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 21 Section "Escutcheons for Fire-Suppression Piping."

Q. The existing building is historic with wood structure and limited infrastructure space. The sprinkler system shall be carefully coordinated and detailed based on the existing building conditions and all other trades. All piping shall be concealed unless otherwise approved. Coordinate exposed locations with the architect and owner prior to installation.

3.5 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 ½” (DN 65) and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 3 (DN 80) and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

3.6 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.
3. Deluge Valves: Install in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

3.7 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Provide head guards on heads in mechanical and electrical rooms, janitor closets, storage rooms, gym and all rooms where heads are exposed.

D. Provide concealed type sprinkler head with flush mounted plate for best seclusion room C128.

3.8 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install flush wall-type, fire-department connections.

B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.9 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run excess-pressure pumps.
6. Coordinate with fire-alarm tests. Operate as required.
7. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.12 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with roll grooved ends; roll grooved-end fittings; roll grooved-end-pipe couplings; and roll grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control vales, instead of specified fittings.

C. Standard-pressure, wet-pipe and dry-pipe sprinkler systems, all piping shall be Schedule 40.

3.13 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers with flush white (or color to match) cover plate.
3. Wall Mounting: Sidewall sprinklers.
4. Spaces subject to freezing: Dry Sprinklers.
5. Rooms with wood finish ceilings: Concealed Sprinklers with custom flush wood finish cover plate to match proposed ceiling system. Refer to architectural drawings for locations.
6. Rooms with other finish ceilings: Concealed sprinklers with matching flush cover plate.
7. Extended coverage sprinkler heads shall be a contractors option where permitted by the authority having jurisdiction.

3.14 LAYOUT

A. Coordinate layout and installation of fire protection system with all other buildings structural, mechanical and electrical work. Locate sprinkler heads in the center of ceiling tiles and symmetrically with respect to ceiling tiles, lighting fixtures, registers, grilles, diffusers, etc. Provide piping offsets as required to maintain symmetry. Sprinkler pipe velocity shall not exceed twenty four (24) feet per second (fps). The system design shall limit maximum demand flow rates at 25% greater than the design requirement established by NFPA. Note that a preliminary sprinkler layout is to be submitted for review. Contractor is cautioned that sprinkler mains must be located to prevent conflicts with other work and in any case, Sprinkler Contractor shall be responsible for coordination of his work with work of other trades. Air terminal devices, units, and equipment shall be indicated on the coordinated layout/shop drawing. For exposed areas, conceal piping and utilize sidewall heads wherever possible, including in conjunction with pendant heads where required.

For exposed piping, get approval from the Architect and Engineer of proposed location and routing prior to fabrication and installation of systems.

B. The attics and areas subject to freezing shall be protected by a dry pipe sprinkler system.

3.15 WET PIPE SPRINKLER SYSTEM:

A. System components shall include flow control valve, electrical connection to central fire alarm system, Siamese fire department connection, check valves, main piping, branch piping, inspector's test, drains, sprinkler heads, and all other incidental appurtenances as required. Provide dry type sprinkler system wherever the sprinkler system is subject to freezing.

3.16 TESTS:

A. The Sprinkler systems installation shall be hydrostatically tested, inspected, and approved, in accordance with NFPA Standard No. 13. Test certificate shall be forwarded to the Office of the State Fire Marshal, and the Local Fire Department, as proof of compliance.

B. Tests shall be performed in accordance with the requirements of the Office of the State Fire Marshal or Local Fire Department, as required, and shall prove the systems to be adequate and satisfactory in every respect. All tests shall be performed in the presence of the State or Local Fire Marshal or his representative.

C. Any deficiencies revealed by these tests shall be corrected and the systems shall be retested until acceptable results are obtained.

3.17 AS-BUILT DRAWINGS:

A. Provide separate as-built drawings of all fire protection systems meeting requirements of General Mechanical Requirements hereinbefore specified. Provide hard copies and electronic copies to the Owner.

3.18 GUARANTEE:

A. The Contractor’s attention is directed to the guarantee obligations contained in the Article of the General Conditions of the specifications entitled "Guarantee".

END OF SECTION

SECTION 21 13 16 - DRY-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Sprinkler specialty pipe fittings.
3. Sprinklers.
4. Alarm devices.
5. Manual control stations.
6. Control panels.
7. Pressure gages.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure 175 psig (1200 kPa) maximum.

1.4 SYSTEM DESCRIPTIONS

A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.

B. Combined Dry-Pipe and Preaction Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Fire-detection system in same area as sprinklers actuates tripping devices that open dry-pipe valve without loss of air pressure and actuates fire alarm. Water discharges from sprinklers that have opened.

C. Single-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of fire-detection system in same area as sprinklers opens deluge valve, permitting water to flow into piping and to discharge from sprinklers that have opened.

D. Double-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of a fire-detection system in the same area as sprinklers opens the deluge valve permitting water to flow into the sprinkler piping; a closed solenoid valve in the sprinkler piping is opened by another fire-detection device; then water will discharge from sprinklers that have opened.

1.5 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.

B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For dry-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Domestic water piping.
2. Compressed air piping.
3. HVAC hydronic piping, duct and HVAC equipment.
4. Items penetrating finished ceiling including the following:

a. Lighting fixtures.
b. Air outlets and inlets.

B. Qualification Data: For qualified Installer and professional engineer.

C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.9 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project. Coordinate location with Owner.

1.10 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.11 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Schedule 40 Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method. Provide threaded ends for pipe sizes 2 ½" (DN 65) and less and roll grooved ends with mechanical couplings for 3 (DN 80) and larger.

B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

C. Galvanized, Steel Couplings: ASTM A 865, threaded.

D. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME B16.1, Class 125.

G. Plain-End-Pipe Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn or screwed retainer pin to secure pipe in fitting.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.

b. Shurjoint Piping Products.

H. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.
b. Corcoran Piping System Co.
c. National Fittings, Inc.
d. Shurjoint Piping Products.
e. Tyco Fire & Building Products LP.
f. Victaulic Company.

2. Pressure Rating: 175 psig (1200 kPa) minimum.
3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast-Iron and Class 300, Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, galvanized steel unless otherwise indicated.

2.4 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:

a. Standard-Pressure Piping Specialty Valves: 175 psig (1200 kPa) minimum.
b. High-Pressure Piping Specialty Valves: 250 psig (1725 kPa) minimum.

3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Dry-Pipe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AFAC Inc.
b. Globe Fire Sprinkler Corporation.
c. Reliable Automatic Sprinkler Co., Inc.
d. Tyco Fire & Building Products LP.
e. Venus Fire Protection Ltd.
f. Victaulic Company.
g. Viking Corporation.

2. Standard: UL 260
3. Design: Differential-pressure type.

4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
5. Air-Pressure Maintenance Device:
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        1) AFAC Inc.
        2) Globe Fire Sprinkler Corporation.
        3) Reliable Automatic Sprinkler Co., Inc.
        4) Tyco Fire & Building Products LP.
        5) Venus Fire Protection Ltd.
        6) Victaulic Company.
        7) Viking Corporation.
    b. Standard: UL 260.
    c. Type: Automatic device to maintain minimum air pressure in piping.
    d. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range, and 175-psig (1200-kPa) outlet pressure.
6. Air Compressor:
    a. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
        1) General Air Products, Inc,
        2) Viking Corporation.
    b. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
    c. Motor Horsepower: Fractional.
    d. Power: 120-V ac, 60 Hz, single phase.

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. AFAC Inc.
    b. Reliable Automatic Sprinkler Co., Inc.
    c. Tyco Fire & Building Products LP.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4 (DN 20).
6. End Connections: Threaded.

2.5 SPRINKLER SPECIALTY PIPE FITTINGS

A. General Requirements for Dry-Pipe-System Fittings: UL listed for dry-pipe service.

B. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Anvil International, Inc.
    b. National Fittings, Inc.
    c. Shurjoint Piping Products.
    d. Tyco Fire & Building Products LP.
    e. Victaulic Company.
2. Standard: UL 213.

3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

C. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AGF Manufacturing Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

D. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Elkhart Brass Mfg. Company, Inc.
   b. Fire-End & Croker Corporation.
   c. Potter Roemer.
2. Standard: UL 199.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

E. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AGF Manufacturing Inc.
   b. Triple R Specialty.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.
   e. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

F. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. CECA, LLC.
   b. Corcoran Piping System Co.

c. Merit Manufacturing; a division of Anvil International, Inc.

2. Standard: UL 1474.
3. Pressure Rating: 250 psig (1725 kPa) minimum.
4. Body Material: Steel pipe with EPDM O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

2.6 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire & Building Products LP.
3. Viking Corporation.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig (1200 kPa) minimum.
3. Provide extended escutcheons in rooms with surface-mounted lighting fixtures.
4. Provide freezeproof heads for loading docks, freezers, etc., where freezing conditions exist.
5. Additional heads shall be furnished as required by NFPA 13. The heads shall be in a cabinet designed to hold the heads and include one sprinkler head wrench for each type of sprinkler. Cabinet shall be mounted where indicated in the field.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.
2. Non-residential applications: UL 199.
3. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. White/Painted.

E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, one piece, flat
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

F. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Reliable Automatic Sprinkler Co., Inc.
b. Tyco Fire & Building Products LP.
c. Viking Corporation.

2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.7 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Globe Fire Sprinkler Corporation.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.

2. Standard: UL 753.
3. Type: Mechanically operated, with Pelton wheel.
4. Alarm Gong: Cast aluminum with red-enamel factory finish.
5. Size: 10-inch (250-mm) diameter.
6. Components: Shaft length, bearings, and sleeve to suit wall construction.
7. Inlet: NPS 3/4 (DN 20).
8. Outlet: NPS 1 (DN 25) drain connection.

C. Pressure Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. AFAC Inc.
   b. Barksdale, Inc.
   c. Detroit Switch, Inc.
   d. Potter Electric Signal Company.
   e. System Sensor; a Honeywell company.
   f. Tyco Fire & Building Products LP.
   g. United Electric Controls Co.
   h. Viking Corporation.

2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

D. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Fire-Lite Alarms; a Honeywell company.
   b. Kennedy Valve; a division of McWane, Inc.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company.

2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

E. Indicator-Post Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Potter Electric Signal Company.
   b. System Sensor; a Honeywell company.

2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.8 MANUAL CONTROL STATIONS

A. Description: UL listed or FM Global approved, hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.9 CONTROL PANELS

A. Description: Single-area, two-area, or single-area cross-zoned type control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.

1. Panels: UL listed and FM Global approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
2. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.
3. Manual Control Stations: Hydraulic operation, with union, NPS 1/2 (DN 15) pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.10 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AMETEK, Inc.; U.S. Gauge Division.
2. Ashcroft, Inc.
3. Brecco Corporation.
4. WIKA Instrument Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.

D. Pressure Gage Range: 0 to 250 psig (0 to 1725 kPa) minimum.

E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform calculations based on a gravity water tank with fire pump in accordance with NFPA requirements. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to the service piping from the fire pump discharge.

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements in NFPA 13 for installation of sprinkler piping.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 ½" (DN 65) and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 3 (DN 80) and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or to outside building.

J. Connect compressed-air supply to dry-pipe sprinkler piping.

K. Connect air compressor to the following piping and wiring:

1. Pressure gages and controls.
2. Electrical power system fire protection contractor requirement. Coordinate with the electrical contractor for power connections. Include all cost in bid.
3. Fire-alarm devices, including low-pressure alarm.

L. Install alarm devices in piping systems.

M. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13 for hanger materials.

N. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each riser. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

O. Drain dry-pipe sprinkler piping.

P. Pressurize and check dry-pipe sprinkler system piping and air-pressure maintenance devices.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210500.

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210500.

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210500.

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 ½" (DN 65) and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 3 (DN 80) and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Rolled-Grooved Joints: Rolled groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

J. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

K. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

L. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.

M. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

N. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Dry-Pipe and Deluge Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
    a. Install air compressor and compressed-air supply piping.
    b. Air-Pressure Maintenance Device: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig (95- to 410-kPa) adjustable range; and 175-psig (1200-kPa) maximum inlet pressure.
    c. Install compressed-air supply piping from building's compressed-air piping system.

3.6 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

3.7 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.11 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-pressure, dry-pipe sprinkler system, NPS 2½" (DN 65) and smaller, shall be one of the following:

1. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

D. Standard-pressure, dry-pipe sprinkler system, NPS 3 (DN 80) and larger, shall be one of the following:

1. Schedule 40, galvanized-steel pipe with rolled-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.12 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers with white coverplate.
3. Wall Mounting: Sidewall sprinklers.
4. Spaces subject to freezing: Dry Sprinklers.

3.13 LAYOUT

A. Coordinate layout and installation of fire protection system with all other buildings structural, mechanical and electrical work. Locate sprinkler heads in the center of ceiling tiles and symmetrically with respect to ceiling tiles, lighting fixtures, registers, grilles, diffusers, etc. Provide piping offsets as required to maintain symmetry. Sprinkler pipe velocity shall not exceed twenty four (24) feet per second (fps). The system design shall limit maximum demand flow rates at 25% greater than the design requirement established by NFPA. Note that a preliminary sprinkler layout is to be submitted for review. Contractor is cautioned that sprinkler mains must be located to prevent conflicts with other work and in any case, Sprinkler Contractor shall be responsible for coordination of his work with work of other trades. Air terminal devices, units, and equipment shall be indicated on the coordinated layout/shop drawing. For exposed areas, conceal piping and utilize sidewall heads wherever possible, including in conjunction with pendant heads where required.

For exposed piping, get approval from the Architect and Engineer of proposed location and routing prior to fabrication and installation of systems.

B. The attics (including roof areas) and external covered areas shall be protected by a dry pipe sprinkler system. The attic(s) roof and majority of the building is wood construction. Attics are naturally ventilated. Extend dry pipe system from fire pump manifold to areas served. Locate air compressor in the mechanical equipment room at the fire pump zone valve manifold. Coordinate air compressor power requirement with the electrical contractor. Additionally, install dry pipe sprinkler systems in areas as regarded by the Authority Having Jurisdiction when installed in a freezing condition as required by NFPA.

3.14 DRY-PIPE SPRINKLER SYSTEM:

A. System components shall include flow control valve, electrical connection to central fire alarm system, Siamese fire department connection, check valves, main piping, branch piping, inspector's test, drains, sprinkler heads, and all other incidental appurtenances as required. Provide dry type sprinkler system wherever the sprinkler system is subject to freezing.

3.15 TESTS:

A. The Sprinkler systems installation shall be hydrostatically tested, inspected, and approved, in accordance with NFPA Standard No. 13. Test certificate shall be forwarded to the Office of the State Fire Marshal, and the Local Fire Department, as proof of compliance.

B. Tests shall be performed in accordance with the requirements of the Office of the State Fire Marshal or Local Fire Department, as required, and shall prove the systems to be adequate and satisfactory in every respect. All tests shall be performed in the presence of the State or Local Fire Marshal or his representative.

C. Any deficiencies revealed by these tests shall be corrected and the systems shall be retested until acceptable results are obtained.

3.16 AS-BUILT DRAWINGS:

A. Provide separate hard and electronic copies of as-built drawings of all fire protection systems meeting requirements of General Mechanical Requirements hereinbefore specified.

3.17 GUARANTEE:

A. The Contractor’s attention is directed to the guarantee obligations contained in the Article of the General Conditions of the specifications entitled "Guarantee".

END OF SECTION

SECTION 21 31 13 – ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vertical in-line fire pumps.
2. Fire-pump accessories and specialties.
3. Flowmeter systems.
4. Overcurrent protection device.

1.3 PERFORMANCE REQUIREMENTS

A. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig (1200 kPa) minimum unless higher pressure rating is indicated.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For fire pumps, motor drivers, and fire-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each fire pump, from manufacturer.

B. Source quality-control reports.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire pumps to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 20, "Installation of Stationary Pumps for Fire Protection."

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.9 WARRANTY

A. Provide three (3) year warranty.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR CENTRIFUGAL FIRE PUMPS

A. Description: Factory-assembled and -tested fire-pump and driver unit.

B. Base: Fabricated and attached to fire-pump and driver unit with reinforcement to resist movement of pump during seismic events when base is anchored to building substrate.

C. Finish: Red paint applied to factory-assembled and -tested unit before shipping.

2.2 IN-LINE CENTRIFUGAL FIRE PUMPS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. A-C Fire Pump Systems; a business of ITT Industries.
2. Patterson Pump Company; a subsidiary of the Gorman-Rupp Company.
3. Peerless Pump, Inc.
4. Pentair Pump Group; Aurora Pump.
5. Pentair Pump Group; Fairbanks Morse.
6. S.A. Armstrong Limited.
7. SynroFlo Fire Pumps.

B. Pump:

1. Standard: UL 448, for split-case pumps for fire service.
2. Casing: Cast iron with ASME B16.1 pipe-flange connections.
3. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
4. Wear Rings: Replaceable bronze.
5. Shaft and Sleeve: Steel shaft with stainless steel sleeve.

a. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
b. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.

6. Mounting: Pump and driver shaft is vertical, with motor above pump and pump on base.

C. Coupling: UL approved and or FM listed flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard.

D. Driver:

1. Standard: UL 1004A.
2. Type: Electric motor; NEMA MG 1, polyphase Design B.

E. Capacities and Characteristics: Refer to Drawings.

2.3 FLOWMETER SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Emerson Process Management; Rosemount Division.
2. Fire Research Corp.
3. Gerand Engineering Co.
4. Hydro Flow Products, Inc.
5. Hyspan Precision Products, Inc.
6. Meriam Process Technologies.
7. Preso Meters; Division of Racine Federated Inc.
8. Victaulic Company.
9. Global Vision Inc.

B. Description: UL-listed or FM-Approved, fire-pump flowmeter system with capability to indicate flow to not less than 175 percent of fire-pump rated capacity.

C. Pressure Rating: 175 psig (1200 kPa) minimum.

D. Sensor: Annubar probe, orifice plate, or venturi unless otherwise indicated. Sensor size shall match pipe, tubing, flowmeter, and fittings.

E. Permanently Mounted Flowmeter: Compatible with flow sensor; with dial not less than 4-1/2 inches (115 mm) in diameter. Include bracket or device for wall mounting.

1. Tubing Package: NPS 1/8 or NPS 1/4 (DN 6 or DN 10) soft copper tubing with copper or brass fittings and valves.

2.4 GROUT

A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink and recommended for interior and exterior applications.

C. Design Mix: 5000-psi (34-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SOURCE QUALITY CONTROL

A. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Production Tests."

1. Verification of Performance: Rate fire pumps according to UL 448.

B. Fire pumps will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

2.6 OVERCURRENT PROTECTION AND DISCONNECT

A. Provide Tornatech model OPD UL listed and FM approved disconnecting device. Provide NFPA 70 (NEC) overcurrent protection as coordination with the electric contractor.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment bases and anchorage provisions, with Installer present, for compliance with requirements and for conditions affecting performance of fire pumps.

B. Examine roughing-in for fire-suppression piping systems to verify actual locations of piping connections before fire-pump installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Fire-Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, provide casing piloted relief valves, and related components.

B. Equipment Mounting: Install fire pumps on concrete bases. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete" and Section 033053 "Miscellaneous Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Install fire-pump suction and discharge piping equal to or larger than sizes required by NFPA 20.

D. Support piping and pumps separately so weight of piping does not rest on pumps.

E. Install valves that are same size as connecting piping. Comply with requirements for fire-protection valves specified in Section 211313 "Wet-Pipe Sprinkler Systems."

F. Install pressure gauges on fire-pump suction and discharge flange pressure-gage tappings. Comply with requirements for pressure gages specified in Section 211313 "Wet-Pipe Sprinkler Systems."

G. Install piping hangers and supports, anchors, valves, gages, and equipment supports according to NFPA 20.

H. Install flowmeters and sensors. Install flowmeter-system components and make connections according to NFPA 20 and manufacturer's written instructions.

I. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.

J. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

3.3 CONNECTIONS

A. Comply with requirements for piping and valves specified in Section 211313 "Wet-Pipe Sprinkler Systems." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps and equipment to allow service and maintenance.

C. Connect relief-valve discharge to drainage piping or point of discharge.

D. Connect flowmeter-system meters, sensors, and valves to tubing.

E. Connect fire pumps to their controllers.

3.4 IDENTIFICATION

A. Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.

3.5 FIELD QUALITY CONTROL

A. Test each fire pump with its controller as a unit. Comply with requirements for electric-motor-driver fire-pump controllers specified in Section 213900 "Controllers for Fire-Pump Drivers."

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. After installing components, assemblies, and equipment including controller, test for compliance with requirements.
2. Test according to NFPA 20 for acceptance and performance testing.
3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

G. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Hoses are for tests only and do not convey to Owner.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire pumps.

3.8 COMMISSIONING

A. The fire pump, jockey pump, air compressor, and fire protection equipment shall be fully commissioned.

END OF SECTION 21 31 13

SECTION 21 34 00 – PRESSURE-MAINTENANCE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Regenerative-turbine or vertical multistage type, pressure-maintenance pumps.

B. Related Section:

1. Section 213900 "Controllers for Fire-Pump Drivers" for pressure-maintenance-pump controllers.

1.3 PERFORMANCE REQUIREMENTS

A. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig (1200 kPa) minimum unless higher pressure rating is indicated.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For pumps, accessories, and specialties. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.9 WARRANTY

A. Provide two (2) year warranty from substantial completion.

PART 2 - PRODUCTS

2.1 REGENERATIVE-TURBINE, PRESSURE-MAINTENANCE PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide MTH Regenerative Turbine or comparable product by one of the following:

1. Pentair Pump Group; Aurora Pump
2. Burks Pumps and Systems; a Crane Co. company.
3. Grundfos Pumps Corporation U.S.A
4. A-C Fire Pump Systems; a business of ITT Industries.

C. Description: Factory-assembled and -tested, close-coupled, single-stage, regenerative-turbine centrifugal pump or vertical multistage type as defined in HI 1.1-1.2 and HI 1.3.

D. Pump Construction:

1. Casing: Vertically split two piece.
2. Impeller: Contoured blade impellers designed to meet low NPSH without efficiency loss.
3. Pump Shaft: Stainless steel.
4. Seal: Mechanical type with spring-loaded rotating head.

E. Motor: Single speed with permanently lubricated ball bearings. Comply with requirements in Section 210513 "Common Motor Requirements for Fire Suppression Equipment."

1. Power Cord: Factory-connected to motor for field connection to controller and at least 10 feet (3 m) long.

F. Nameplate: Permanently attached to pump and indicating capacity and characteristics.

G. Capacities and Characteristics:

1. Refer to Drawings.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 210513 "Common Motor Requirements for Fire Suppression Equipment."

1. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. NFPA Standard: Comply with NFPA 20 for installation of pressure-maintenance pumps.

B. Base-Mounted Pump Mounting: Install pumps on concrete bases. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Attach pumps to equipment base using anchor bolts.

C. Install regenerative-turbine or vertical multistage, pressure-maintenance pumps according to HI 1.4.

D. Coordinate all requirements with the Electrical Contractor at the shop drawing phase through the installation phase.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Pressure-maintenance pumps will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.3 ADJUSTING

A. Lubricate pumps as recommended by manufacturer.

B. Set field-adjustable pressure-switch ranges as indicated.

END OF SECTION 21 34 00

SECTION 21 39 00 – CONTROLLERS FOR FIRE-PUMP DRIVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Full-service, reduced-voltage controllers rated 600 V and less.
2. Controllers for pressure-maintenance pumps.
3. Remote alarm panels.
4. Low-suction-shutdown panels.

1.3 DEFINITIONS

A. ATS: Automatic transfer switch(es).

B. ECM: Electronic control module.

C. MCCB: Molded-case circuit breaker.

D. N.O.: Normally open.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each type of product indicated. Include dimensioned plans, elevations, sections, details, and attachments to other work, including required clearances and service spaces around controller enclosures.

1. Show tabulations of the following:

a. Each installed unit's type and details.
b. Enclosure types and details for types other than NEMA 250, Type 2.
c. Factory-installed devices.
d. Nameplate legends.
e. Short-circuit current (withstand) rating of integrated unit.
f. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices.
g. Specified modifications.

2. Detail equipment assemblies and indicate dimensions, weights, loads, method of field assembly, components, and location and size of each field connection.
3. Schematic and Connection Diagrams: For power, signal, alarm, and control wiring and for pressure-sensing tubing.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Certificates: For each type of product indicated, from manufacturer.

C. Manufacturer's factory test reports of fully assembled and tested equipment.

D. Source quality-control reports.

E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product indicated to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
2. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor-based logic controls.

1.7 WARRANTY

A. Provide five (5) year parts and labor warranty for all fire pump controllers.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of an NRTL.

B. Source Limitations: Obtain fire-pump controllers and all associated equipment from single source or producer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with standards of authorities having jurisdiction pertaining to materials and installation.

E. Comply with NFPA 20 and NFPA 70.

F. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.10 COORDINATION

A. Coordinate layout and installation of controllers with other construction including conduit, piping, fire-pump equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels. Ensure that controllers are within sight of fire-pump drivers.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 FULL-SERVICE CONTROLLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Firetrol Products.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. Tornatech.
4. Master Control Systems.

B. General Requirements for Full-Service Controllers:

1. Comply with NFPA 20 and UL 218.
2. Listed by an NRTL for electric-motor driver for fire-pump service.
3. Combined automatic and nonautomatic operation.
4. Factory assembled, wired, and tested; continuous-duty rated.
5. Service Equipment Label: NRTL labeled for use as service equipment.

C. Method of Starting:

1. The electric fire pump controller shall be a full-service combined manual automatic type suitable for reduced voltage soft start-stop parting of the electric fire pump motor with or without ATS. Part-

winding, primary reactor/resistor, limited service controllers and wye delta-OPEN controllers shall not be permitted.

2. Pressure -switch actuated.
   a. Water-pressure-actuated switch and pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire-suppression piping.
   b. Pressure and event recording
      1) Shall be capable of logging pressure data and operational events with time and date stamps.
      2) Shall be able to display operational events for the life of the controller, and display the pressure data in text and/or graphic form.
      3) Data shall be retrievable and downloadable to a flash memory disk via the USB port accessible to the user without having to open the controller door.
         a) All time statistics
            i. First start up
            ii. On time
         b) First and last service statistics
            i. First setup
            ii. On time
            iii. Motor statistics:
               a. On time
               b. Start count
               c. Last start time
            iv. Minimum, maximum, average system pressure
            v. Minimum, maximum, average pump room temperature
            vi. Jockey pump controller
               a. On time
               b. Start count
               c. Last start time
         c) Power statistics
            i. Voltage between phases with date stamp
            ii. Amperage per phase with date stamp
   c. Programmable minimum-run-time relay to prevent short cycling.
   d. Programmable timer for weekly tests.
3. Short Circuit Withstand Rating
   a. The short circuit withstand rating of the electric fire pump controller shall be 100,000 RMS at 200V-480V.
4. The electric fire pump controller shall be supplied with a pressure transducer run test solenoid valve assembly. The pressure sensing line connection to the pressure transducer shall be ½" FNPT. Provisions for a redundant pressure transducer shall be provided. This assembly shall be rated for 600psi working pressure and be externally mounted with a protective cover.
5. Service/Flow Testing Capabilities
   a. The electric fire pump controller's touch screen operator interface shall have the capability of scheduling maintenance reminders. It shall also have the capability of inputting pump flow test data, generate and display the pump curve and store this information in memory for the lifetime of the controller.

D. Method of Stopping: Automatic and nonautomatic shutdown after automatic starting.

E. Capacity: Rated for fire-pump-driver horsepower and short-circuit-current (withstand) rating equal to or greater than short-circuit current available at controller location.

F. Method of Isolation and Overcurrent Protection: Interlocked isolating switch and nonthermal MCCB; with a common, externally mounted operating handle, and providing locked-rotor protection.

G. Door-Mounted Operator Interface and Controls:

1. Monitor, display, and control the devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
2. Method of Control and Indication:

   a. Microprocessor-based logic controller, with multiline digital readout.
   b. Membrane keypad.
   c. LED alarm and status indicating lights.

3. Local and Remote Alarm and Status Indications:

   a. Controller power on.
   b. Motor running condition.
   c. Loss-of-line power.
   d. Line-power phase reversal.
   e. Line-power single-phase condition.
   f. Transfer Switch Position.

4. Audible alarm, with silence push button.
5. Nonautomatic START and STOP push buttons or switches.

H. Features To be Provided:

1. Extra Output Contacts:

   a. One N.O. contact(s) for motor running condition.
   b. One set(s) of contacts for loss-of-line power.
   c. One each, Form C contacts for high and low reservoir level.

2. Local alarm bell.
3. Door-mounted thermal or impact printer for alarm and status logs.
4. Operator Interface Communications Ports: USB, Ethernet, and RS485.
5. Interlock with building BACNET automatic temperature control system.
6. Pilot Lamp: Indicate circuit breaker closed and power available.

I. ATS:

1. Complies with NFPA 20, UL 218, and UL 1008.
2. Integral with controller as a listed combination fire-pump controller and power transfer switch.
3. Automatically transfers fire-pump controller from normal power supply to alternate power supply in event of power failure.
4. Allows manual transfer from one source to the other.
5. Alternate-Source Isolating and Disconnecting Means: Integral molded-case switch, with an externally mounted operating handle.
6. Alternate-Source Isolating and Disconnecting Means: Mechanically interlocked isolation switch and circuit breaker rated at a minimum of 115 percent of rated motor full-load current, with an externally mounted operating handle; circuit breaker shall be provided with nonthermal sensing, instantaneous-only short-circuit overcurrent protection to comply with available fault currents.
7. Local and Remote Alarm and Status Indications:

   a. Normal source available.
   b. Alternate source available.
   c. In normal position.
   d. In alternate position.
   e. Isolating means open.
   f. Phase Reversal.
   g. Pump Running.

8. Audible alarm, with silence push button.
9. Nonautomatic (manual, nonelectric) means of transfer.
10. Engine test push button.
11. Start generator output contacts.
12. Timer for weekly generator tests.

2.2 CONTROLLERS FOR PRESSURE-MAINTENANCE PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Firetrol Products.
2. Tornatech.
3. Master Control Systems.

B. General Requirements for Pressure-Maintenance-Pump Controllers:

1. Type: UL 508 factory assembled, -wired, and tested, across-the-line; for combined automatic and manual operation.
2. Enclosure: UL 508 and NEMA 250, Type 2 for wall-mounting.
3. Factory assembled, wired, and tested.
4. Finish: Manufacturer's standard color paint.

C. Rate controller for scheduled horsepower and include the following:

1. Non fused – magnetically held breaker disconnect switch.
2. Pressure switch.
3. Hand-off-auto selector switch.
4. Pilot light.
5. Running period timer.
6. Full voltage starter.
7. Independent “high” and “low” adjustment points or pressure switch.

2.3 ENCLOSURES

A. Fire-Pump Controllers, ATS, Remote Alarm Panels, and Low-Suction-Shutdown Panels: NEMA 250 Type 2, to comply with environmental conditions at installed locations and NFPA 20.

1. Other Wet or Damp, Indoor Locations: Type 4 (IEC IP56).

B. Enclosure Color: Manufacturer's standard "fire-pump-controller red".

C. Nameplates: Comply with NFPA 20; complete with capacity, characteristics, approvals, listings, and other pertinent data.

D. Features:

1. Floor stands, 12 inches (305 mm) high, for floor-mounted controllers.

2.4 SOURCE QUALITY CONTROL

A. Testing: Test and inspect fire-pump controllers according to requirements in NFPA 20 and UL 218.

1. Verification of Performance: Rate controllers according to operation of functions and features specified.

B. Fire-pump controllers will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive equipment, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine equipment before installation. Reject equipment that is wet or damaged by moisture or mold.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONTROLLER INSTALLATION

A. Install controllers within sight of their respective drivers.

B. Connect controllers to their dedicated pressure-sensing lines.

C. Floor-Mounting Controllers: Install controllers on 4-inch (100-mm) nominal-thickness concrete bases, using floor stands high enough so that the bottom of enclosure cabinet is not less than 12 inches (305 mm) above finished floor. Installation of floor mounted controllers with factory supplied legs are acceptable. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Comply with NEMA ICS 15.

F. Coordinate all requirements with the Electrical Contractor at the shop drawing phase through the installation phase.

3.3 POWER WIRING INSTALLATION

A. Install power wiring between controllers and their services or sources, and between controllers and their drivers. Comply with requirements in NFPA 20, NFPA 70, and Section 260519 "Low-Voltage Electrical Power Conductors and Cables." All control cabling between the Fire Pump Control Panel and Emergency Generator shall have a minimum 2-Hour Fire Rating. Product must be MI cable, 2-inch concrete encasement or other approved UL listed assemblies.

3.4 CONTROL AND ALARM WIRING INSTALLATION

A. Install wiring between controllers and remote devices and facility's central monitoring system. Comply with requirements in NFPA 20, NFPA 70, and Section 260523 "Control-Voltage Electrical Power Cables."

B. Install wiring between controllers and the building's fire-alarm system. Comply with requirements specified in Section 283111 "Digital, Addressable Fire-Alarm System."

C. Bundle, train, and support wiring in enclosures.

D. Connect remote manual and automatic activation devices where applicable.

3.5 IDENTIFICATION

A. Comply with requirements in NFPA 20 for marking fire-pump controllers.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification in NFPA 20 and as specified in Section 260553 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Inspect and Test Each Component:

a. Inspect wiring, components, connections, and equipment installations. Test and adjust components and equipment.
b. Test insulation resistance for each element, component, connecting supply, feeder, and control circuits.
c. Test continuity of each circuit.

2. Verify and Test Each Electric-Driver Controller:

a. Verify that voltages at controller locations are within plus 10 or minus 1 percent of motor nameplate rated voltages, with motors off. If outside this range for any motor, notify Construction Manager before starting the motor(s).
b. Test each motor for proper phase rotation.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Field Acceptance Tests:

1. Do not begin field acceptance testing until suction piping has been flushed and hydrostatically tested and the certificate for flushing and testing has been submitted to Construction Manager and authorities having jurisdiction.
2. Prior to starting, notify authorities having jurisdiction of the time and place of the acceptance testing.
3. Engage manufacturer's factory-authorized service representative to be present during the testing.
4. Perform field acceptance tests as outlined in NFPA 20.

F. Controllers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.8 ADJUSTING

A. Adjust controllers to function smoothly and as recommended by manufacturer.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, and timers.

C. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

D. Set field-adjustable pressure switches.

3.9 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.

B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controllers, and to use and reprogram microprocessor-based controls within this equipment.

END OF SECTION 21 39 00

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Concrete bases.
11. Supports and anchorages.

B. Provide all labor, materials, equipment, and services necessary for and incidental to the complete installation and operation of all mechanical work.

C. Unless otherwise specified, all submissions shall be made to, and acceptances and approvals made by the Architect and the Engineer.

D. Contract Drawings are generally diagrammatic and all offsets, fittings, transitions and accessories are not necessarily shown. Furnish and install all such items as may be required to fit the work to the conditions encountered. Arrange piping, equipment, and other work generally as shown on the contract drawings, providing proper clearance and access. Where departures are proposed because of field conditions or other causes, prepare and submit detailed shop drawings for approval in accordance with "Submittals" specified below. The right is reserved to make reasonable changes in location of equipment, piping, and ductwork, up to the time of rough-in or fabrication.

E. Conform to the requirements of all rules, regulations and codes of local, state and federal authorities having jurisdiction.

F. Coordinate the work under Division 22 with the work of all other construction trades.

G. Be responsible for all construction means, methods, techniques, procedures, and phasing sequences used in the work. Furnish all tools, equipment and materials necessary to properly perform the work in first class, substantial, and workmanlike manner, in accordance with the full intent and meaning of the contract documents.

H. Coordinate with all exterior work with the sprinkler contractor.

I. Coordinate all exterior work with the site/general trades contractor.

J. The plumbing contractor shall provide all condensate drain piping and all gas piping to mechanical equipment connections.

K. All domestic water system materials (pipes, tanks, pumps, valves, solder etc.) shall be NSF61/ANSI372 certified as lead free.

L. The existing building is historic and primarily wood construction. All systems and installations shall be fully coordinated with all other trades.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations. Coordinate the work under Division 22 with work of all other construction trades. Conform to the requirements of all rules, regulations, and Codes of local, state, and Federal Authorities Having Jurisdiction.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces.

1.8 PERMITS AND FEES

A. Obtain all permits and pay taxes, fees and other costs in connection with the work. File necessary plans, prepare documents, give proper notices and obtain necessary approvals. Deliver inspection and approval certificates to Owner prior to final acceptance of the work.

B. Permits and fees shall comply with the General Requirements of the specification.

1.9 EXAMINATION OF SITE:

A. Examine the site, determine all conditions and circumstances under which the work must be done, and make all necessary allowances for same. No additional cost to the Owner will be permitted for Contractor's failure to do so.

1.10 CONTRACTOR QUALIFICATION

A. Any Contractor or Subcontractor performing work under Division 22 shall be fully qualified and acceptable to the Architect. Submit the following evidence if requested.

1. A list of not less than five comparable projects that the Contractor completed.
2. Letter of reference from not less than three registered professional engineers, Contractors or building owners.
3. Local and/or State License, where required.
4. Membership trade or professional organizations where required.

B. A Contractor is any individual, partnership, or corporation, performing work by contract or subcontract on this project.

C. Acceptance of a Contractor or Subcontractor will not relieve the Contractor or subcontractor of any contractual requirements or his responsibility to supervise and coordinate the work, of various trades.

1.11 MATERIALS AND EQUIPMENT

A. Materials and equipment installed as a permanent part of the project shall be new, unless otherwise indicated or specified, and of the specified type and quality. This Contractor shall be responsible for connecting all utilities as shown on the drawings, to equipment identified as "under another Division".

B. Where material or equipment is identified by proprietary name, model number and/or manufacturer, furnish named item, or its equal only of other manufacturers who are indicated in this specification, subject to approval by the Engineer and the Owen J. Roberts School District. Alternate manufacturers or items other than the first-named shall be equal or better in quality and performance and must be suitable for available space, required arrangement, and application. Submit all data necessary to determine suitability of substituted items, for approval.

C. The suitability of named item only has been verified. Where more than one item is named, only the first named item has been verified as suitable. Alternate manufacturers/items are items other than first named which shall be equal or better in quality and performance to that of specified items, and must be suitable for available space, required arrangement and application. Manufacturers not named are not acceptable and shall not be submitted.

D. Substitution will not be permitted for specified items of material or equipment where only one manufacturer is identified.

E. The Contractor shall only submit those manufacturers indicated in the specification. Proposed alternate manufacturers must be approved by the Owner and be included into the specifications by Addenda. Substitutions are for materials or manufacturers not listed in this specification. For each substitution proposed by the Contractor, the Contractor shall clearly indicate all differences from the specified item, change in Contract cost, benefit to the Owner and a brief description why the substitution is being proposed. Refer to the General Conditions for additional information. The Owner shall ultimately accept/reject all substitution requests. Refer to the General Conditions of this specification for additional information.

1.12 FIRE SAFE MATERIALS

A. Unless otherwise indicated, materials and equipment shall conform to UL, NFPA OR ASTM Standards for Fire Safety with Smoke and Fire Hazard Rating not exceeding flame spread of 25 and smoke developed of 50.

1.13 REFERENCED STANDARDS, CODES AND SPECIFICATIONS:

A. Specifications, Codes and Standards listed below are included as part of this specification, latest edition.

AABC	-	Associated Air Balance Council
ABMA	-	American Boiler Manufacturers Association
ACCA	-	Air Conditioning Contractors of America
ACGIH	-	American Conference of Governmental Industrial Hygienist
ADC	-	Air Diffusion Council
AIHA	-	American Industrial Hygiene Association
AGA	-	American Gas Association
AMCA	-	Air Movement and Control Association
ANSI	-	American National Standards Institute
ARI	-	Air Conditioning and Refrigeration Institute

ASA	-	Acoustical Society of America
ASHRAE	-	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing and Materials
AWWA	-	American Water Works Association
CABO	-	Council of American Building Officials
CAGI	-	Compressed Air and Gas Institute
CS	-	Commercial Standard
CSA	-	Canadian Standards Association
CTI	-	Cooling Tower Institute
HEI	-	Heat Exchanger Institute
HI	-	Hydraulic Institute
HYDI	-	Hydronics Institute
IAPMO	-	International Association of Plumbing and Mechanical Officials
IBC	-	International Building Code
IBR	-	Institute of Boiler and Radiator Manufacturers
ICBO	-	International Conference of Building Officials
IEEE	-	Institute of Electrical and Electronics Engineers
IFCI	-	International Fire Code Institute
IMC	-	International Mechanical Code
IPC	-	International Plumbing Code
MSSP	-	Manufacturers Standards Society of the Valve and Fittings Industry
NEC	-	National Electrical Code
NEMA	-	National Electrical Manufacturers Association
NFPA	-	National Fire Protection Association
NSF Int.	-	National Sanitation Foundation
SMACNA	-	Sheet Metal and Air Conditioning Contractors National Association
TEMA	-	Tubular Exchanger Manufacturers Association
UL	-	Underwriters' Laboratories

B. All mechanical equipment and materials shall comply with the Codes and Standards listed in the latest ASHRAE and ASPE Handbooks.

1.14 SUBMITTALS, REVIEW AND ACCEPTANCE:

A. Equipment, materials, installation, workmanship and arrangement of work are subject to review and acceptance. No substitution will be permitted after acceptance of equipment or materials except where such substitution is considered by the Engineer to be in best interest of Owner.

B. With 30 calendar days after award of contract, submit a complete Material and Equipment List for approval. List all proposed materials and equipment, indicating proposed manufacturer, type, class, model and other general identifying information.

C. After acceptance of Material and Equipment List, submit complete descriptive data for all items. Data shall consist of specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, wiring diagrams, installation instructions, and any other information necessary to indicate complete compliance with Contract Documents. Edit submittal data specifically for application to this project.

D. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and any electrical requirements for equipment submitted. Contractor shall be responsible for correctness of all submittals. Each piece of equipment and its associated components (e.g., relays, fuses, disconnects, etc.) shall be clearly identified.

E. Submittals will be reviewed for general compliance with design concept in accordance with contract documents, but dimensions, quantities, or other details will not be verified.

F. Identify submittals, indicating intended application, location and service of submitted items. Refer to specification sections or paragraphs where applicable. Clearly indicate exact type, model number, style, size and special features of proposed item. Submittals of a general nature will not be acceptable. For items other than first-named, clearly list on the first page of the submittal all differences between the specified item and the proposed item. The Contractor shall be responsible for all additional cost and for corrective action (or replacement with the specified item) while maintaining the specification requirements if differences have not been clearly indicated in the submittal.

G. Submit actual operating conditions or characteristics, including NC Levels, for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable.

H. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted.

1.15 SHOP DRAWINGS:

A. Prepare and submit shop drawings for all specially fabricated items, modifications to standard items, specially designed systems where detailed design is not shown on the contract drawings, or where the proposed installation differs from that shown on contract drawings.

B. Submit data and shop drawings as listed below, in addition to provisions of Paragraph A above. Identify all shop drawings by the name of the item and system and the applicable specification paragraph number.
Items and Systems Not Limited to:

Access Doors.
Backflow Preventer.
Capacitors.
Fire Stopping - Methods and Materials.
Floor & Roof Drains.
Flowmeters and Primary Elements. (Flow Fittings)
Hose Bibbs & Wall Hydrants.
Identification System.
Mixing Valve, Temperature Limiting Valves.
Pipe Guides and Anchors.
Pipes and Fittings.
Plumbing Fixtures & Trim.
Pressure Regulating Valve.
Pressure Reducing Valve.
Pressure Relief Valve.
Sleeves and Sealants.
Strainers.
Thermal Insulation Materials.
Thermometers and Gauges.
Trap Seals.
Valves - Globe, Angle, Check, Plug, Butterfly, Ball.

C. The Contractor, additionally, shall submit for approval any other shop drawings as required by the Architect. No item listed above shall be delivered to the site, or installed, until approved. After the proposed materials have been approved, no substitution will be permitted except where approved by the Architect.

1.16 SUPERVISION AND COORDINATION:

A. Provide complete supervision, direction, scheduling, and coordination of all work under the Contract, including that of subcontractors.

B. Coordinate rough-in of all work and installation of sleeves, anchors, and supports for piping, and other work performed under Division 22.

C. Coordinate electrical work required under Division 22 with that under Division 26. Coordinate all work under Division 22 with work under all other Divisions.

1.17 CUTTING AND PATCHING:

A. Accomplish all cutting and patching necessary for the installation of work under Division 22. Damage resulting from this work to other work already in place, shall be repaired at Contractor's expense. Where cutting is required, saw-cut or core drill only, and perform work in neat and workmanlike manner. Use mechanics skilled in the particular trades required.

B. Do not cut structural members without approval.

1.18 PENETRATION OF WATERPROOF CONSTRUCTION:

A. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls, and interior waterproof construction. Where such penetrations are necessary, furnish and install all necessary curbs, sleeves, flashings, fittings and caulking to make penetrations absolutely watertight.

B. Where plumbing vents or other pipes penetrate roofs, flash pipe with All American, Inc., or approved equal, roof flashing assemblies, 6-inch skirt, cap, and caulked counterflashing sleeve.

C. Furnish pipe curbs and portals where required. Pitch pockets are prohibited.

D. Furnish and install roof drains, curbs, vent assemblies, and duct sleeves specifically designed for application to the particular roof construction, and install in accordance with the manufacturer's instructions, The National Roofing Contractors Association, SMACNA and as required by other divisions of this specification. The Contractor shall be responsible for sleeve sizes and locations.

1.19 VIBRATION ISOLATION

A. Furnish and install vibration isolators, flexible connections, supports, anchors, and/or foundations required to prevent transmission of vibration from equipment or piping to building structure.

1.20 ACCESSIBILITY

A. All equipment shall be installed in such a way that all components requiring access are so located and installed that they may be serviced, reset, replaced, recalibrated, etc., by service technicians in accordance with the Manufacturer’s recommendations. If any equipment or components are located in such a position that this Contractor cannot comply with the above, the Contractor shall notify the Engineer in writing before equipment is installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, galvanized steel, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Dresser Industries, Inc.; DMD Div.
c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
d. JCM Industries.
e. Smith-Blair, Inc.
f. Viking Johnson.

2. Underground Piping NPS 1-1/2 (DN 40) and Smaller: Manufactured fitting or coupling.
3. Underground Piping NPS 2 (DN 50) and Larger: AWWA C219, metal sleeve-type coupling.
4. Aboveground Pressure Piping: Pipe fitting.

B. Plastic-to-Metal Transition Fittings: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

a. Eslon Thermoplastics.
b. Charlotte Pipe.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

a. Thompson Plastics, Inc.
b. Charlotte Pipe**.**

D. Plastic-to-Metal Transition Unions: MSS SP-107, PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Manufacturers:

a. NIBCO INC.
b. NIBCO, Inc.; Chemtrol Div.
c. Charlotte Pipe**.**

E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Fernco, Inc.
c. Mission Rubber Company.
d. Plastic Oddities, Inc.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

1. Manufacturers:

a. Epco Sales, Inc.
b. Watts Industries, Inc.; Water Products Div.
c. Flowset.

D. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

1. Manufacturers:

a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America.

E. Dielectric Unions and Couplings are prohibited.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.
e. Garlock/LinkSeal

2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Reinforced Nylon polymer. Include two for each sealing element.
4. Connecting Bolts and Nuts: Type 316 Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, galvanized, plain ends.

B. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

C. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

C. One-Piece, Floor-Plate Type: Cast-iron floor plate.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.

M. Provide seismic expansion loops at building expansion joints refer to architectural drawings for locations.

N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are two pipe sizes larger than pipe or pipe insulation.

    a. Galvanized Steel Pipe Sleeves: For pipes through walls and floors except where noted through membrane waterproofing.
    b. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing. Seal space outside of sleeve fittings with grout.
    c. Provide galvanized steel sheet sleeves for interior stud partitions.
    d. Provide galvanized steel wall sleeves with sleeve seal system for walls below grade and concrete slabs on grade. Select sleeve size to allow one-inch annular clear space between piping and sleeve for installing sleeve seal system. Select type, size and number of sealing elements required for piping material and size for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve system components and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a water-tight seal.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size two pipe sizes larger than pipe and sleeve for installing mechanical sleeve seals.

Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" with water stops for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

S. Verify final equipment locations for roughing-in.

T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.
5. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

C. Provide protective finishes on all materials and equipment. Use coated or corrosion-resistant materials, hardware and fittings throughout the work. Paint bare, untreated ferrous surfaces with rust-inhibiting paint. All exterior components including supports, hangers, vibration isolators, etc., shall be galvanized or stainless steel. All fasteners including nuts, bolts, washers, rods, etc., shall be stainless steel.

D. Clean surfaces prior to application of insulation, adhesives, coatings, paint, or other finishes.

E. Provide factory-applied finishes where specified. Unless otherwise indicated factory-applied paints shall be baked enamel with proper pretreatment.

F. Protect all finishes and restore any finishes damaged as a result of work under Division 22 to their original condition.

G. The preceding requirements apply to all work, whether exposed or concealed.

H. Remove all construction marking and writing from exposed equipment, piping and building surfaces. Do not paint manufacturer's labels or tags.

I. All exposed piping, equipment, cast iron boots, etc. shall be painted. Colors shall be selected by the Architect and conform to ANSI Standards.

3.6 CONCRETE BASES

A. Concrete Bases: Provide concrete bases for plumbing equipment. Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 5000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section “Miscellaneous Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.9 SUPPORTS AND HANGERS

A. Provide supports, hangers, braces, attachments and foundations required for the work. Support and set the work in a thoroughly substantial and workmanlike manner without placing strains on materials, equipment, or building structure, submit shop drawings for approval. Coordinate all work with the requirements of the structural division.

B. Supports hangers, braces, and attachments shall be standard manufactured items or fabricated structural steel shapes. All interior hangers shall be galvanized or steel with rust inhibiting paint. For uninsulated copper piping/tubing provide copper clad hanger. All exterior hangers shall be constructed of galvanized steel or stainless steel utilizing stainless steel rods, nuts, washers, bolts, etc.

3.10 PROVISIONS FOR ACCESS:

A. The Contractor shall provide access panels and doors for all concealed equipment, valves, strainers, cleanouts, traps, and other devices requiring maintenance, service, adjustment, balancing or manual operation.

B. Where access doors are necessary, furnish and install manufactured steel door assemblies consisting of hinged door, cylinder locks (keyed alike)**,** and frame designed for the particular wall or ceiling construction. Properly locate each door. All proposed access door locations shall be approved by the Architect prior to installation. Door size shall be a minimum of 24" x 24" unless otherwise approved by the Architect/Engineer. Provide UL Approved and labeled access doors where installed in fire rated walls or ceilings. Doors shall be Milcor Metal Access Doors as manufactured by Inland-Ryerson, or approved equal.

1. Acoustical or Cement Plaster: Style B
2. Hard Finish Plaster: Style K or L
3. Masonry or Dry Wall: Style M

C. Where access is by means of lift-out ceiling tiles or panels, mark each panel using small color-coded or numbered tabs. Provide a chart or index for identification. Charts shall be similar to valve charts specified hereinafter. Provide chart in O & M Manual and in the Boiler Room. Screw markers shall be mounted on the ceiling grid using districts standard for marking and ID.

D. Access panels, doors, etc., described herein shall be furnished under the section of specifications providing the particular service to be turned over to the pertinent trade for installation. Coordinate installation with installing Contractor. Coordinate locations with the Architect prior to installation.

3.11 PROTECTION OF WORK:

A. Protect work, material and equipment from weather and construction operations before and after installation. Properly store and handle all materials and equipment.

B. Cover temporary openings in piping and equipment to prevent the entrance of water, dirt, debris, or other foreign matter.

C. Cover or otherwise protect all finishes.

D. Replace damaged materials, devices, finishes and equipment.

3.12 OPERATION OF EQUIPMENT:

A. Clean all systems and equipment prior to initial operation for testing, or other purposes. Lubricate, adjust, and test all equipment in accordance with manufacturer's instructions. Do not operate equipment unless all proper safety devices or controls are operational. Provide all maintenance and service for equipment that is authorized for operation during construction.

B. Provide the services of the manufacturer's factory-trained servicemen or technicians to start up the equipment.

C. Do not use plumbing systems for temporary services during construction unless authorized in writing by the Owner or Architect. Where such authorization is granted, temporary use of equipment shall in no way limit or otherwise affect warranties or guaranty period of the work. All equipment safeties shall be functional and equipment operated within the recommended and designed parameters.

D. Upon completion of work, clean and restore all equipment to new conditions; replace expendable items such as filters, blowdown all strainers, etc.

3.13 IDENTIFICATIONS, FLOW DIAGRAMS, ELECTRICAL DIAGRAMS AND OPERATING INSTRUCTIONS

A. Contractor shall submit for approval schematic piping diagrams of each piping system installed in the building. Diagrams shall indicate valve location, service, type (i.e., butterfly, globe, ball, etc.) make, model number and the identification number of each valve in the particular system. Following approval by all authorities, the diagrams shall be framed, mounted under glass and hung in the Mechanical Room where directed. Contractor shall deliver the AutoCAD or Revit developed color print from which the diagrams were reproduced to the Owner.

B. All valves shall be plainly tagged.

C. All items of equipment shall be furnished with white letters and numbers on laminated identification plates using the districts coding system to match districts PM system requirements. Lettering shall be a minimum of 1/4" high. Identification plates shall be securely affixed to each piece of equipment, starters, panels, etc., by screws or adhesive (Tuff-bond #TB2 or as approved equal). Pressure sensitive tape backing is prohibited for all concealed equipment and devices located above drop tile ceilings.

D. Provide three (3) copies of operating and maintenance instructions for all principal items of equipment furnished. This material shall be bound as a volume of the "Record and Information Booklet" complete with electronic copy as hereinafter specified.

E. All lines (piping) installed under this contract shall be stenciled with "direction of flow" arrows and with stenciled letters naming each pipe and service.

3.14 WALL AND FLOOR PENETRATION:

A. All penetrations of partitions, ceilings, and floors by piping or conduit under Division 22 shall be sealed and caulked airtight for sound and air transfer control and/or fire stopped for fire walls and floors.

3.15 RECORD DRAWINGS:

A. Upon completion of the plumbing installations, the Contractor shall deliver to the Architect one complete set of the plumbing contract drawings which shall be legibly marked in red pencil to show all changes and

departures of the installation as compared with the original design. They shall be suitable for use in preparation of Record Drawings. Additionally the contractor shall provide an electronic copy of the record drawings.

3.16 GUARANTEE:

A. Contractor's attention is directed to guarantee obligations contained in the GENERAL CONDITIONS.

B. The above shall not in any way void or abrogate equipment manufacturer's guarantee or warranty. Certificates of guarantee shall be included in the operations and maintenance manuals.

C. Contractor shall also provide, when due to malfunction, two (2) year free service, from the time of final acceptance by the Owner, to keep the equipment in operating condition. This service shall be rendered upon request when notified of any equipment malfunctions.

D. All refrigeration compressors shall be provided with a five (5) year parts and labor warranty, including replacement of refrigerant.

E. Provide extended warranty for specific equipment were specified.

3.17 LUBRICATION

A. All bearings, motors, and all equipment requiring lubrication shall be provided with accessible fittings for same. Before turning over the equipment to the Owner, the Contractor shall fully lubricate each item of equipment, shall provide one year's supply of lubricant for each, and shall provide Owner with complete written lubricating instructions, together with diagram locating the points requiring lubrication. Include this information in the Record and Information Booklet.

B. In general, all motors and equipment shall be provided with grease lubricated roller or ball bearings with Alemite or equal accessible or extended grease fittings and drain plugs.

C. Provide pressure relief fittings at all grease lubrication locations designed to automatically vent within the range of 1/4 to 1 psi, automatically reset below this range, or another pressure relief range if the preceding differs from the manufacturer's recommended pressure range.

3.18 RECORD AND INFORMATION BOOKLET:

A. The Contractor shall have prepared three (3) copies of the Record and Information Booklet and deliver these copies of the booklet to the Owner. The booklet shall be as specified herein. The booklet must be approved and will not be accepted as final until so stamped.

B. The booklet shall be bound in a three-ring loose-leaf binder similar to "National" No. 3881 with the following title lettered on the front: "Record and Information Booklet (insert name of the project)". No sheets larger than 8-1/2" x 11" shall be used, except sheets that may be neatly folded to 8-1/2" x 11" and used as a pull-out.

C. All booklet information shall also be provided in electronic format, PDF files, stored on an external hard drive. Each binder shall contain an envelope sleeve containing the electronic format media (external hard drive).

D. Provide the following data in the booklet:

1. Catalog data on each piece of plumbing equipment furnished.
2. Maintenance operation and lubrication instructions on each piece of equipment furnished.
3. Complete catalog data on each piece of plumbing equipment furnished, including approved shop drawings.

4. Manufacturer's and Contractors' guarantees.
5. Chart form indicating time and type of routine maintenance of plumbing equipment. The chart shall also indicate tag number, model number of equipment, location and service. For replacement items such as filters, indicate type, size and quantity of the replaceable items.
6. Provide sale and service representatives' names and phone numbers of all equipment and subcontractors.
7. Catalog data of all equipment valves, etc., which shall include wiring diagrams, parts list and assembly drawing.
8. Provide valve chart including valve tag number, valve type, valve model number, valve manufacturer, style, service and location, etc., as specified hereinafter.
9. Provide certification that lead-free and asbestos-free products were provided.
10. Provide operating curves indicating design and balanced conditions for pumps.
11. Provide copies of all flushing reports.
12. Provide copies of all start-up reports.
13. External hard drive of all demonstration and instructional periods.
14. External hard drive of all coordination drawings.

3.19 TESTS, GENERAL:

A. The entire new plumbing systems shall be tested hydrostatically for a duration of four (4) hours before insulation covering is applied and provided tight under the following gauge pressures:

1.	Domestic Water & Coil Drain Piping:	100 psi
2.	Sanitary & Storm Water Piping:	as specified below
3.	Natural Gas:	100 psi

B. All storm, waste, vent and water piping shall be tested by the Contractor and approved by the Engineer and local code official before acceptance. All storm, soil, and waste piping, located underground, shall be tested before backfilling. The costs of all equipment required for tests are to be included under the contract price.

C. The entire new drainage system and venting system shall have all necessary openings plugged and filled with water to the level of the highest stack above or at the roof. The system shall hold this water for thirty (30) minutes without showing a drop greater than 1". Where a portion of the system is to be tested, the test shall be conducted in the same manner as described for the entire system, except a vertical stack 10 feet above the highest horizontal line to be tested may be installed and filled with water to maintain sufficient pressure, or a pump may be used to supply the required pressure. The pressure shall be maintained for thirty (30) minutes.

D. Upon completion of roughing-in and before setting fixtures, the entire new water piping system shall be tested at a hydrostatic pressure of not less than one hundred (100) pounds per square inch gauge and proved tight at this pressure. Where a portion of the water piping system is to be concealed before completion, this portion shall be tested separately in a manner described for the entire system.

E. All testing shall be witnessed by local code official and the owner. The Contractor shall provide a minimum of 48-hour notice before testing. The Contractor shall coordinate with and get approval from the Owner.

F. Gas Testing:

1. Before any section of a gas piping system is put into service, it shall be carefully tested to assure that it is gastight. Prior to testing, the system shall be blown out, cleaned, and cleared of all foreign material. Each joint shall be tested by means of an approved gas detector, soap and water, or an equivalent nonflammable solution. Testing shall be completed before any work is covered, enclosed, or concealed. All testing of piping system shall be done with due regard for the safety of employees and the public during the test. All testing and purging shall comply with local utility company requirements. Bulkheads, anchorage and bracing suitably designed to resist test pressures shall be installed if necessary. Oxygen shall not be used as a testing medium.
2. Pressure Tests: Before appliances are connected, piping systems shall be filled with air or an inert gas and shall withstand a minimum pressure of 3 pounds gauge for a period of not less than 10 minutes as specified in NFPA 54 without showing any drop in pressure. Oxygen shall not be used.

Pressure shall be measured with a mercury manometer, slope gauge, or an equivalent device so calibrated as to be read in increments of not greater than 0.1 pound. The source of pressure shall be isolated before the pressure tests are made.

3. Test with Gas: Before turning gas under pressure into any piping, all openings from which gas can escape shall be closed. Immediately after turning on the gas, the piping system shall be checked for leakage by using a laboratory-certified gas meter, an appliance orifice, a manometer, or equivalent device. All testing shall conform to the requirements of NFPA 54. If leakage is recorded, the gas supply shall be shut off, the leak shall be repaired, and the tests repeated until all leaks have been stopped.
4. Purging: After testing is completed, and before connecting any appliances, all gas piping shall be fully purged. Piping shall not be purged into the combustion chamber of an appliance. The open end of piping systems being purged shall not discharge into confined spaces or areas where there are ignition sources unless the safety precautions recommended in NFPA 54 are followed.
5. Labor, Materials, and Equipment: All labor, materials, and equipment necessary for conducting the testing and purging shall be furnished by the Contractor.

3.20 LINTELS:

A. Under this Section, provide lintels not provided elsewhere which are required for openings for the installation of plumbing work. Lintels shall meet the requirements of the Architectural and Structural Sections and The Architectural Drawings and Specifications.

3.21 EQUIPMENT BY OTHERS

A. This Contractor shall make all system connections required to equipment furnished and installed under other divisions. Connections shall be complete in all respects to render this equipment functional to its fullest intent.

B. It shall be the responsibility of the supplier of this equipment to furnish complete instructions for connections.

C. Typical equipment refers to, but is not limited to: Storage cabinets and all other kitchen equipment.

3.22 FASTENERS:

A. All fasteners located in public space shall be provided with tamper-proof type fasteners where specifically indicated.

3.23 WIRING DIAGRAMS

A. Obtain and submit wiring diagrams for all equipment provided under this Contract.

B. Wiring diagrams shall be provided with Shop Drawings for similar to, but not limited to, the following:

1. All equipment.

C. The Contractor shall submit any additional wiring diagrams as requested by the Engineer.

D. Provide wiring diagrams and identify all termination points, connections, and interface points for all major mechanical equipment to the Electrical Contractor and the ATC Subcontractor for coordination.

3.24 INSTALLATION AND COORDINATION DRAWINGS;

A. Prepare, submit, and use composite installation and coordination drawings to assure proper coordination and installation of work. Drawings shall include, but not be limited, to the following: Complete Ductwork, Plumbing, Sprinkler and HVAC Piping Drawings showing coordination with approved equipment, approved casework drawings, lights, electrical equipment and structural. The Mechanical Contractor is responsible for coordinating with all trades to insure systems will fit in the available space. If conflicts exist after fabrication and/or installation of systems prior to preparing a coordinated drawing of the area, the Contractor shall remove, re-fabricate, and re-install all such work at their own cost, except for the difference in cost, if any, from the originally designed system to the revised design. If no design changes were made, and clarifications were required, it shall be at no expense to the Owner.

B. Draw plans to a scale not less than 3/8-inch equals one foot. Include plans, sections, and elevations of proposed work, showing all equipment, piping and ductwork in areas involved. Fully dimension all work including hoods, casework and associated utilities, valve boxes, lighting fixtures, conduits, pullboxes, panelboards, and other electrical work, telecommunications equipment, walls, doors, ceilings, columns, beams, joists and other architectural and structural work. Division 23 shall coordinate the development of composite coordination drawings.

C. Identify all equipment and devices on wiring diagrams and schematics. Where field connections are shown to factory-wired terminals, include manufacturer's literature showing internal wiring.

D. All coordination drawings shall be prepared in AutoCAD or Revit format and submitted in color. Different colors shall be used to determine different building components. In addition to the composite coordination drawings, simultaneously submit individual sheet-metal, piping, plumbing and sprinkler coordination drawings.

E. The Mechanical Contractor shall schedule bi-weekly Coordination Drawing Reviews with the Owner, Mechanical Engineer, and all associated subcontractors, including but not limited to the following:

1. Mechanical Contractor
2. Finishes Contractor
3. Sheet Metal Contractor
4. Sprinkler Contractor
5. Electrical Contractor
6. Plumbing Contractor
7. Owner/Architect/Engineer/Construction manager
8. Note: A Foreman or Project Manager responsible for Decision-Making of each company shall attend all Coordination Meetings.

F. The purpose of these meetings is to coordinate proposed installations of systems and equipment, including clearances, routing, penetrations, as well as to review potential conflicts. The Mechanical Contractor shall base preliminary equipment sizes and connections on proposed products and the final coordination drawing for review shall reflect approved/reviewed products. Coordination Meetings shall be held at the Contractor’s Field Office.

3.25 BOILER AND PRESSURE VESSELS

A. All boilers and pressure vessels shall be ASME-rated and shall comply with the State of Pennsylvania, latest requirements.

B. Provide all control devices and materials, and install in with ASME CSD-1 controls and safety devices for automatically fired boilers.

3.26 FACTORY START-UP

A. Provide factory authorized start-up service for all plumbing equipment. Coordinate with the Commissioning Agent.

B. Provide one copy of all start-up reports to the Owner and include a copy in the O&M Manual.

C. Tempering Valves: Provide factory-authorized individual to review installation and develop a report to submit to the Engineer. Report submission shall be prior to Engineer's Punch-Out and Demonstration/Training.

D. The Contractor shall be required to start up all systems in an orderly, organized, and coordinated manner to ensure that all systems are functioning as designed. The Contractor shall provide a detailed start-up, testing and demonstration plan for all systems in a coordinated manner that is documented in writing at least forty-five (45) days prior to start-up. Start-up, testing, and demonstration plans shall include detailed point-by-point check list that clearly shows that systems are in face functioning as designed. The A/E shall include modifications to the standard AIA definition of substantial completion to indicate that Mechanical/Electrical Systems are not substantially complete until all systems are started, tested, balanced, and O&M Manuals are received by the Owner. Above listed items must be completed in time to allow for system demonstrations to Owner Personnel with all O&M Manuals in hand at the time of demonstration. Contractors will be required to provide system demonstrations and training for Owner Personnel for each system. At minimum, the Contractors shall provide eight (8) hours of demonstration and eight (8) hours of systems operation training for each system prior to Owner acceptance of any given system.

3.27 PLUMBING INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of plumbing systems, materials, and equipment including, but not limited to, the following:

1. Coordinate plumbing systems, equipment and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed, noted, or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished space.
10. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of equipment components in accordance with manufacturers' recommendations. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
11. Install access panels or doors where units are concealed behind finished surfaces.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
13. Install above-ceiling equipment requiring servicing and/or maintenance within 48" of accessible ceilings/access panels.
14. Test and balance the domestic hot water/hot water recirculation system.

15. Where different pipe sizes are indicated on the Drawings, the largest pipe size shall be used for the basis of the Bid.

3.28 SCHEDULING OF WORK AND OUTAGES

A. All required outages shall be coordinated with and approved by the Owner a minimum of fourteen (14) days in advance. Written notice of not less than fourteen (14) calendar days shall precede any outage. The Contractor shall include in their bid outages and/or work in occupied areas to occur during weekends, holidays, or at night. No outages are allowed during school hours.

END OF SECTION

SECTION 22 05 13 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Split phase.
2. ECM.

B. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

C. Motors 1/20 HP and Smaller: Shaded-pole type or ECM as indicated on the drawings.

D. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 22 05 19 - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Liquid in glass thermometers.
2. Thermowells.
3. Dial-type pressure gauges.
4. Gauge attachments.
5. Test plugs.
6. Test-plug kits.
7. Sight flow indicators.

B. Related Sections:

1. Division 21 fire-suppression piping Sections for fire-protection pressure gauges.
2. Division 22 Section "Facility Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.
3. Division 22 Section " Domestic Water Piping" for water meters inside the building.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Certificates: For each type of meter and gauge, from manufacturer.

C. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

D. NSF-61 and ANSI372 compliance for all products that will come in contact with potable water.

1.4 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of meter and gauge from single source from single manufacturer.

B. NSF Compliance: NSF 61 and ANSI372 Certified Lead Free for valve materials for potable-water service.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial Style, Liquid-in-Glass Thermometers.

1. Basis-of-Design Product: Subject to compliance with requirements, provide H.O. Trerice Model BX9 Industrial thermometer or comparable product by one of the following:

   a. Ashcroft, Inc.
   c. Trerice, H.O. Co.
   d. Weiss Instruments, Inc.

2. Standard: ASME B40.200.
3. Case: Cast aluminum 9-inch (229-mm) nominal size unless otherwise indicated.
4. Case Form: Back angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in deg F (deg C).
7. Window: Glass.
8. Stem: Brass adjustable angle, brass stem and of length to suit installation.

   a. Design for Air-Duct Installation: With ventilated shroud.
   b. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: Brass.
4. Material for Use with Steel Piping: Brass.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

C. Where wells are installed in pipe tees at turns, increase pipe size so that well does not restrict flow.

2.3 PRESSURE GAUGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Trerice, Model 600C, or comparable product by one of the following:

   a. Ashcroft Inc.
   b. Ernst Flow Industries.
   c. Miljoco Corporation.
   d. Noshok.
   e. Weiss Instruments, Inc.

2. Standard: ASME B40.100.
3. Case: Liquid-filled, sealed, type(s); cast aluminum or drawn steel; 4-1/2-inch (114-mm) nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.
12. All gauges at pumps shall be liquid filled type.

2.4 GAUGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass threaded needle valve with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. National Meter, Inc.
3. Peterson Equipment Co., Inc.
4. Sisco Manufacturing Company, Inc.
5. Trerice, H. O. Co.
6. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
7. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 (DN 8) or NPS 1/2 (DN 15), ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 300 psig at 250 deg F (2070 kPa at 121 deg C).

F. Core Inserts: EPDM self-sealing rubber.

2.6 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. National Meter, Inc.
3. Peterson Equipment Co., Inc.
4. Sisco Manufacturing Company, Inc.
5. Trerice, H. O. Co.
6. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
7. Weiss Instruments, Inc.

B. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gauge and adapter, and carrying case. Thermometer sensing elements, pressure gauge, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F (minus 4 to plus 52 deg C).

D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F (minus 18 to plus 104 deg C).

E. Pressure Gauge: Small, Bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be at least 0 to 200 psig (0 to 1380 kPa).

F. Carrying Case: Metal or plastic, with formed instrument padding.

2.7 SIGHT FLOW INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Archon Industries, Inc.
2. Dwyer Instruments, Inc.
3. Emerson Process Management; Brooks Instrument.
4. Ernst Co., John C., Inc.
5. Ernst Flow Industries.
6. KOBOLD Instruments, Inc. - USA; KOBOLD Messring GmbH.
7. OPW Engineered Systems; a Dover company.
8. Penberthy; A Brand of Tyco Valves & Controls - Prophetstown.

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

D. Minimum Pressure Rating: 125 psig (860 kPa).

E. Minimum Temperature Rating: 200 deg F (93 deg C).

F. End Connections for NPS 2 (DN 50) and Smaller: Threaded.

G. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.

G. Install valve and snubber in piping for each pressure gauge for fluids.

H. Install test plugs in piping tees.

I. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.
2. Where indicated on the drawings.

J. Install pressure gauges in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump, liquid filled.
4. Where indicated on the drawings.

3.2 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance of meters, gauges, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gauges to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:

1. Compact, industrial-style, liquid-in-glass type.
2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

B. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F (Minus 20 to plus 50 deg C).

B. Scale Range for Domestic Hot-Water Piping: 30 to 240 deg F (0 to plus 115 deg C).

3.6 PRESSURE-GAUGE SCHEDULE

A. Pressure gauges at discharge of each water service into building shall be selected so that the thermal readings are at the approximate mid-point and maximum pressures. Do not exceed full scale.

END OF SECTION

SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Bronze lift check valves.
3. Bronze swing check valves.
4. Bronze globe valves.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61Certified Lead Free for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 4” and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 3 and smaller.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 2 plug valves, for each size square plug-valve head.
5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.

3. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
f. NIBCO.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full Port

B. Cast Iron Flanged Ball Valve with Stainless Steel Trim:

1. American valve series 4000 or equal, 4” and larger, full port.

2.3 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.4 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.

b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.5 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron**,** bronze, or aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball valves.
2. Throttling Service: Globe or ball.
3. Pump-Discharge Check Valves:

   a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze disc.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded or solder joint valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 6 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port bronze with stainless-steel trim; cast iron flanged, full port 4”and larger.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Globe Valves: Class 125, bronze disc.

END OF SECTION

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Pipe stands.
5. Pipe positioning systems.
6. Equipment supports.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 21 fire-suppression piping Sections for pipe hangers for fire-suppression piping.
3. Division 22 Section "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of cadmium plated or stainless steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-clad hanger, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of cadmium plated or stainless steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Clement Support Services.
2. ERICO International Corporation.
3. National Pipe Hanger Corporation.
4. PHS Industries, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa) minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.4 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.

C. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb. Supports shall be hot-dipped galvanized construction. All fasteners, washers, etc., shall be stainless steel.

2.5 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes, hot-dipped galvanized construction.

2.7 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black (painted) and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Do not use powder activated fastener systems

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.

G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.

H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Pipe hangers and supports shall be attached to the panel point at the top chord of bar joist or at a location approved by the structural engineer. Do not support all parallel piping from the same bar joist (4” pipe and larger) unless approved by structural engineer.

O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

P. Insulated Piping:

1. Attach clamps and spacers to piping.

   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.

5. Pipes NPS 2 (DN 50) and Larger: Include wood or reinforced calcium-silicate-insulation load bearing (100 PSI) thermal inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

Q. The building is primarily wood construction

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections**.**

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use copper or copper clad attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use painted or galvanized carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications. Use stainless steel pipe hangers and attachments for exterior applications.

F. Use thermal-hanger shield inserts for insulated piping and tubing.

G. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
3. Adjustable Roller Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

   a. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
   b. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.

H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
2. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape at the panel point.
2. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
3. Side Beam Clamps (MSS Type 27): For bottom of steel I-Beams.

K. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
2. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

L. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system sections.

M. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system sections.

N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments only where required in concrete construction. Obtain written approval from the architect and structural engineer where fastener systems are required.

O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply waste piping for plumbing fixtures.

END OF SECTION

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number based on PM Identification System of the school district, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Black.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, snap-on semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive (4” and less). For larger pipe (sizes 6” and greater) markers shall be strapped around using nylon ties.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME (ANSI) A13.1 for piping; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Fiberboard or metal.
2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel in colors according to ASME (ANSI) A13.1 unless otherwise indicated.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) black-filled letters for piping system abbreviation and 1/2-inch (13-mm) black-filled numbers, 2-inch diameter.

1. Tag Material: Brass, 19 gauge minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass jack chain.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches (100 by 178 mm).
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09.

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME (ANSI) A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 25 feet along each run. Reduce intervals to 15 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
8. Where pipes are adjacent to each other, markings shall be neatly lined up. All markings shall be located in such a manner to be easily legible from the floor.
9. For piping less than 3/4 inch, provide permanently legible tag as specified hereinbefore for valve identification.
10. For buried piping, provide 2-inch minimum width with plastic identification/detection tape with metallic core. Install 4 to 6-inches below-grade.

D. Pipe Label Color Schedule:

1. Natural Gas:

   a. Background Color: Yellow.
   b. Letter Color: Black.

2. Domestic Water Piping:

   a. Background Color: Green.
   b. Letter Color: White.

3. Sanitary Waste and Storm Drainage Piping:

   a. Background Color: Green.
   b. Letter Color: White.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

   a. Cold Water: 2 inches (50 mm), round.
   b. Hot Water: 2 inches (50 mm), round.
   c. Natural Gas: 2 inches (50 mm), round.

2. Valve-Tag Color:

   a. Cold Water: Natural.
   b. Hot Water: Natural.
   c. Natural Gas: Natural.

3. Letter Color:

   a. Cold Water: Black.
   b. Hot Water: Black.
   c. Natural Gas: Black.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 22 07 00 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Insulation Materials:
   a. Calcium silicate.
   b. Flexible elastomeric.
   c. Mineral fiber.
2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied cloths.
10. Field-applied jackets.
11. Tapes.
12. Securements.
13. Corner angles.

B. Related Sections include the following:

1. Division 23 Section "HVAC Insulation."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail field application for each equipment type.

C. Qualification Data: For qualified Installer.

D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers,

attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

E. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Calcium Silicate:

1. Products: Subject to compliance with requirements, provide the following:

   a. Owens-Corning.
   b. Johns Mansville.

2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
3. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide the following:

   a. Johns Mansville.
   b. Armacell LLC; AP Armaflex.
   c. Aeroflex USA, Inc.; Aerocel.
   d. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

H. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Johns Manville; Micro-Lok.
   b. Knauf Insulation; 1000(Pipe Insulation.
   c. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. CertainTeed Corp.; CrimpWrap.
   b. Johns Manville; MicroFlex.
   c. Knauf Insulation; Pipe and Tank Insulation.
   d. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Insulco, Division of MFS, Inc.; Triple I.
b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F (10 to 427 deg C).

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-97.
b. Foster Products Corporation, H. B. Fuller Company; 81-27/81-93.
c. Marathon Industries, Inc.; 290.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Chemical Company (The); 739, Dow Silicone.
b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Speedline Vinyl Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-30.
b. Foster Products Corporation, H. B. Fuller Company; 30-35.
c. ITW TACC, Division of Illinois Tool Works; CB-25.
d. Marathon Industries, Inc.; 501.
e. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; Encacel.
b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
c. Marathon Industries, Inc.; 570.
d. Mon-Eco Industries, Inc.; 55-70.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-10.
b. Foster Products Corporation, H. B. Fuller Company; 35-00.
c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
d. Marathon Industries, Inc.; 550.
e. Mon-Eco Industries, Inc.; 55-50.
f. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms (2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F (Minus 29 to plus 93 deg C).
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-52.
b. Foster Products Corporation, H. B. Fuller Company; 81-42.
c. Marathon Industries, Inc.; 130.
d. Mon-Eco Industries, Inc.; 11-30.
e. Vimasco Corporation; 136.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
4. Service Temperature Range: Minus 50 to plus 180 deg F (Minus 46 to plus 82 deg C).
5. Color: White.

2.6 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-76-8.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms (0.013 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

   a. Products: Subject to compliance with requirements, provide the following:
      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

5. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms (0.007 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

   a. Products: Subject to compliance with requirements, provide the following:
      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

   a. Products: Subject to compliance with requirements, provide the following:
      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.8 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto PVC Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

5. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; Metal Jacketing Systems.
b. PABCO Metals Corporation; Surefit.

2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
e. Factory-Fabricated Fitting Covers:
1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

D. Underground Direct-Buried Jacket: 125-mil- (3.2-mm-) thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Pittsburgh Corning Corporation; Pittwrap.
b. Polyguard; Insulrap No Torch 125.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches (75 mm).

3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   b. Compac Corp.; 110 and 111.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
   d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
   b. Compac Corp.; 130.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
   d. Venture Tape; 1506 CW NS.

2. Width: 2 inches (50 mm).
3. Thickness: 6 mils (0.15 mm).
4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
   b. Compac Corp.; 120.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
   d. Venture Tape; 3520 CW.

2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.

2. Width: 3 inches (75 mm).
3. Film Thickness: 6 mils ((0.15 mm)).
4. Adhesive Thickness: 1.5 mils (0.04 mm).

5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch (10.1 N/mm) in width.

2.11 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Products; Bands.
   b. PABCO Metals Corporation; Bands.
   c. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 3/4 inch (19 mm) wide with wing or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm) wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated.

   a. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; CD.
      3) Midwest Fasteners, Inc.; CD.
      4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

   a. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; Cupped Head Weld Pin.
      3) Midwest Fasteners, Inc.; Cupped Head.
      4) Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
      2) GEMCO; Perforated Base.
      3) Midwest Fasteners, Inc.; Spindle.

   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
   c. Spindle: Stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Products: Subject to compliance with requirements, provide one of the following:

1) GEMCO; Nylon Hangers.
2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the following:
1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
2) GEMCO; Press and Peel.
3) Midwest Fasteners, Inc.; Self Stick.

b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
c. Spindle: Stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Products: Subject to compliance with requirements, provide one of the following:
1) AGM Industries, Inc.; RC-150.
2) GEMCO; R-150.
3) Midwest Fasteners, Inc.; WA-150.
4) Nelson Stud Welding; Speed Clips.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Products: Subject to compliance with requirements, provide one of the following:
1) GEMCO.
2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C & F Wire.
b. Childers Products.
c. PABCO Metals Corporation.
d. RPR Products, Inc.

2.12 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.

B. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel accord.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.

   a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

Q. Provide load bearing (100 PSIG) calcium silicate thermal inserts at hangers for piping 2 NPS (DN 50) and larger.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Division 07 Section "Penetration Firestopping"irestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

   a. Do not weld anchor pins to ASME-labeled pressure vessels.
   b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
   c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.

d. Do not overcompress insulation during installation.
e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
f. Impale insulation over anchor pins and attach speed washers.
g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches (75 mm).
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

3.6 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.7 CALCIUM SILICATE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

4. Finish flange insulation same as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

3.8 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.10 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant

recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches (50 mm) over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. The 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.11 FINISHES

A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

   a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.13 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

C. Domestic cold-water storage tank insulation shall be the following, of thickness to provide an R-value of 12.5:

1. Mineral-Fiber Board: 3-lb/cu. ft. (48-kg/cu. m) nominal density.

3.14 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Underground piping.

3.15 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. Two-inch (2”) pipe size and Smaller: Insulation shall be the following:

a. Molded fiberglass 1/2 inch thick.

2. Two-and-one-half-inch (2-1/2”) pipe size and Larger: Insulation shall be the following:

a. Molded fiberglass 1-inch thick.

3. Half-inch (1/2”) run-out piping: Insulation shall be one of the following:

a. Molded fiberglass 1/2-inch thick.
b. Flexible Elastomeric: 1/2 inch (13 mm) thick.

B. Domestic Hot and Recirculated Hot Water:

1. One-and one-quarter-inch (1-1/2”) pipe size and Smaller: Insulation shall be the following:

a. Molded fiberglass 1-inch thick.

2. One and one-half-inch (1-1/2”) and Larger: Insulation shall be the following:

a. Molded fiberglass 1-1/2 inch thick.

3. Half-inch (1/2”) run-out piping: Insulation shall be one of the following:

a. Molded fiberglass 1-inch thick.
b. Flexible Elastomeric: 1 inch (25 mm) thick.

C. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be the following:

a. Molded fiberglass 1-inch thick.

D. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be one of the following:

   a. Flexible Elastomeric: 1 inch (25 mm) thick.
   b. Molded fiberglass 1-inch thick.

E. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

1. All Pipe Sizes: Insulation shall be one of the following:

   a. Flexible Elastomeric: 1 inch (25 mm**)** thick.
   b. Molded fiberglass 1-inch thick.

F. Exposed Sanitary Drains, domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be Truebro Lav Guard – ADA approved undersink pipe insulation cover system. Refer to Section 224000 for additional information on protective shielding guards.

G. Floor Drains, Traps, and Sanitary Drain Piping within 10 feet (3m) of drain receiving condensate and equipment drain water below 60 degrees F (16 degrees C):

1. All Pipe Sizes: Insulation shall be the following:

   a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-inch (25 mm) thick.

H. Hot Service Drains:

1. All Pipe Sizes: Insulation shall be the following: Mineral-Fiber, Preformed Pipe, Type I or II: 1-inch (25 mm) thick.

I. Hot Service Vents:

1. All Pipe Sizes: Insulation shall be the following: Mineral-Fiber, Preformed Pipe, Type I or II: 1-inch (25 mm) thick.

J. Piping with Heat Trace:

1. All pipe sizes (condensate drain piping subject to freezing): Insulation shall be the following: Mineral-Fiber, Preformed Pipe, Type I or II: 1-inch (25 mm) thick.

3.16 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Equipment, Exposed, up to 48 inches (1200 mm) in Diameter or with Flat Surfaces up to 72 inches (1800 mm):

1. PVC: 30 mils (0.8 mm) thick.

D. Equipment, Exposed, Larger than 48 inches (1200 mm) in Diameter or with Flat Surfaces Larger than 72 inches (1800 mm):

1. Aluminum with 0.040 inch (1.0 mm) thick.

E. Piping, Concealed:

1. None.

F. Piping, Exposed in occupied areas and/or where Heat Traced:

1. Indoor PVC: 20 mils (0.5 mm) thick, Green with White lettering for identification).
2. Exterior – Aluminum: 0.040 inch thick.

END OF SECTION

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Piping Materials.
2. Copper Tube and Fittings
3. Ductile Iron Pipe and Fittings
4. Piping Joining Materials.
5. Transition Fittings
6. Dielectric Fittings
7. Specialty Valves.
8. Flexible connectors.
9. Water Meters.

B. Related Section:

1. Division 22 Section "Facility Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.3 SUBMITTALS

A. Product Data: For the following products:

1. Specialty valves.
2. Piping
3. Transition fittings.
4. Dielectric fittings.
5. Flexible connectors.
6. Backflow preventers and vacuum breakers.
7. Water penetration systems.

B. Water Samples: Specified in "Cleaning" Article.

C. Coordination Drawings: For all piping, draw to 3/8” scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Fire-suppression-water piping.
2. Domestic water piping.
3. HVAC hydronic piping.
4. Equipment.
5. Ductwork.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61 and HB 372 for potable domestic water piping and components.

1.5 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube Above-Ground: ASTM B 88, Type L water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

B. Soft Copper Tube Below Building Slab: ASTM B 88, Type K (ASTM B 88M, Type A) water tube, annealed temper in PVC conduit.

1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.3 DUCTILE IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.
2. Compact-Pattern, Mechanical-Joint Fittings: AWWA C153, ductile iron.

   a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

3. Lining: AWWA C104, cement mortar.
4. Gaskets: AWWA C111, rubber.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, galvanized steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cascade Waterworks Manufacturing.
b. Dresser, Inc.; Dresser Piping Specialties.
c. Smith-Blair, Inc; a Sensus company.
d. Viking Johnson; c/o Mueller Co.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. EPCO Sales, Inc.
b. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
c. Hart Industries International, Inc.

2. Description:

a. Factory-fabricated, bolted, companion-flange assembly.
b. Pressure Rating: 150 psig (1035 kPa).
c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

C. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Perfection Corporation; a subsidiary of American Meter Company.
b. Precision Plumbing Products, Inc.
c. Victaulic Company.

2. Description:

a. Electroplated steel nipple complying with ASTM F 1545.
b. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
c. End Connections: Male threaded or grooved.
d. Lining: Inert and noncorrosive, propylene.

D. Dielectric unions and couplings are prohibited.

2.7 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Flex Pression, Ltd.
4. Flex-Weld, Inc.
5. Hyspan Precision Products, Inc.
6. Mercer Rubber Co.
7. Metraflex, Inc.
8. Proco Products, Inc.
9. Tozen Corporation.
10. Unaflex, Inc.
11. Universal Metal Hose; a Hyspan company
12. Mason Industries.

B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

2.8 WATER METERS

A. Displacement-Type Water Meters (1-1/4” and Smaller):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Seametrics
   b. Badger Meter, Inc.
   c. Sensus Metering Systems.
   d. Hersey Meter.

2. Description:

   a. Standard: AWWA C700.
   b. Pressure Rating: 150-psig (1035-kPa) working pressure.
   c. Body Design: Nutating disc; totalization meter.
   d. Registration: In gallons or cubic feet as required by utility. In gallons for make-up water and other building sub-metering requirements.
   e. Case: Bronze.
   f. End Connections: Threaded.
   g. Energy Management: Connection to the BACNET (Building Management System).

B. Electromagnetic-Type Water Meters (1-1/2” and Larger):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Seametrics
   b. Badger Meter, Inc.
   c. Sensus Metering Systems.
   d. Hersey Meter.
   e. Onicon.

2. Description:

   a. Standard: AWWA C701.
   b. Pressure Rating: 150-psig (1035-kPa) working pressure.

c. Body Design: Turbine; totalization meter.
d. Registration: In gallons or cubic feet as required by utility company. In gallons for make-up water and other building sub-metering requirements.
e. Case: Stainless Steel.
f. End Connections for Meters NPS 2 (DN 50) and Smaller: Threaded.
g. End Connections for Meters NPS 2-1/2 (DN 65) and Larger: Flanged.
h. Energy Management: Connection to the BACNET Building Management System.

3. Incoming water service: To be furnished by the utility company for installation by the contractor. Coordinate requirements with the utility company and the owner.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install shutoff valve, hose-end drain valve, strainer, pressure gauge, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gauges for Plumbing Piping" for pressure gauges and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.

E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.

G. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

I. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

K. Install piping adjacent to equipment and specialties to allow service and maintenance.

L. Install piping to permit valve servicing.

M. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

N. Install piping free of sags and bends.

O. Install fittings for changes in direction and branch connections.

P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

Q. Install liquid filled pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22.

R. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22.

S. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22.

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22.

U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22.

V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22.

W. Install underground copper tube and ductile iron pipe in PE encasement according to ASTM A674 or AWWA C105.

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

H. Ductile-Iron-Piping Grooved Joints: Cut groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join ductile-iron pipe and grooved-end fittings according to AWWA C606 for ductile-iron-pipe, cut-grooved joints.

I. Steel-Piping Grooved Joints: Roll groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

J. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

3.4 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, for each branch serving toilet room(s), for each branch pipe serving two or more fixtures, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 2 (DN 50) and smaller. Use butterfly or ball valves for piping NPS 2-1/2 (DN 65) and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section.

1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

D. Install combination balancing/shut-off valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22.

3.5 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
2. NPS 2 (DN 50) and Larger: Sleeve-type coupling.

3.6 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric nipples only.

C. Dielectric Fittings for NPS 2-1/2 and larger: Use dielectric flanges only.

3.7 FLEXIBLE CONNECTOR INSTALLATION

A. Install flexible connectors in suction and discharge piping connections to each domestic water pump.

B. Install bronze-hose flexible connectors in copper domestic water tubing.

3.8 WATER METER INSTALLATION

A. Rough-in domestic water piping and install water meters according to utility company's requirements and/or as required for building sub-metering.

B. Install water meters according to AWWA M6 and/or the utility company's requirements

C. Install displacement-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.

D. Install turbine-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.

E. Install remote registration system according to standards of utility company and of authorities having jurisdiction.

F. Provide remote reading for integration with the BACNET Building Control System.

3.9 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:
   a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet (30 m) If Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
5. NPS 3 (DN 80): 10 feet (3 m) with 1/2-inch (13-mm) rod.
6. NPS 4 (DN 150): 12 feet (3 m) with 5/8-inch (16-mm) rod.
7. NPS 6 (DN 200): 12 feet (3 m) with 3/4-inch (19-mm) rod.

F. Install supports for vertical copper tubing every 10 feet (3 m).

G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

H. Hangers shall be connected to top chord panel points at joist locations.

3.10 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

3.11 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.12 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
   a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.13 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
   b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.14 CLEANING

A. Clean and disinfect potable and non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:
      1) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
   c. Flush system with clean, potable water until chlorine level is <1.0 ppm in water coming from system after the standing time.
   d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
   e. Submit testing results to Architect.

3.15 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Under-building slab, fire-service-main piping, NPS 4 to NPS 12, shall be the following:

1. Mechanical-joint, ductile-iron pipe; standard-pattern mechanical-joint fittings; and mechanical joints.

D. Above Ground Domestic Water Piping:

1. All aboveground domestic water piping shall be the following

a. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) or wrought- copper solder-joint fittings; and soldered joints.

2. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall be the following:

   a. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) copper solder-joint fittings; and soldered joints.

3. Under-Building Slab, Domestic Water Piping:

   a. Type K, annealed-temper soft copper tubing, wrought copper fittings and solder joints in PVC conduit.

3.16 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for all piping. Use ball valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
2. Throttling Duty: Use ball valves for piping NPS 4 (DN 100) and smaller. Use ball valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION

SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Balancing valves.
3. Temperature-actuated water mixing valves.
4. Strainers.
5. Hose bibbs.
6. Wall hydrants.
7. Non-Freeze Post Hydrants
8. Drain valves.
9. Water hammer arresters.
10. Air vents.
11. Trap-seal primer valves.
12. Trap-seal primer systems.

B. Related Sections include the following:

1. Division 22 Section "Meters and Gauges for Plumbing Piping" for thermometers, pressure gauges, and flow meters in domestic water piping.
2. Division 22 Section "Domestic Water Piping" for water meters.
3. Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa), unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: Diagram power, signal, and control wiring.
C. Field quality-control test reports.
D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. NSF Compliance:

1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."
2. All components shall be certified as Lead Free in accordance with NSF 61.

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Ames Company.
   b. Cash Acme.
   c. Conbraco Industries, Inc.
   d. Watts Industries, Inc.; Water Products Division.
   e. Zurn Plumbing Products Group; Wilkins Division.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome-plated.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. MIFAB, Inc.
   b. Watts Industries, Inc.; Water Products Div.
   c. Conbraco Industries, Inc.
   d. Zurn Plumbing Products Group; Wilkins Div.
   e. Josam.
   f. Chicago.

2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Ames Company.
   b. Conbraco Industries, Inc.
   c. Watts Industries, Inc.; Water Products Division.
   d. Zurn Plumbing Products Group; Wilkins Division.

2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
5. Accessories: Valves – Ball type, on inlet and outlet.

2.2 BALANCING VALVES

A. Memory-Stop Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Div.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. Watts.
h. Tour and Anderson.

2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
4. Size: NPS 2 (DN 50) or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Stainless steel
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

B. Primary, Thermostatic, Water Mixing Valves

1. Refer to drawings for additional information.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
4. Type: Exposed-mounted thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Settings: 115°F
9. Manufacturers: Powers or Leonard.

2.3 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Individual-Fixture, Water Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Watts.
b. Lawler Manufacturing Company, Inc.
c. Powers; a Watts Industries Co.

2. Standard: ASSE 1070, thermostatically controlled water tempering valve.
3. Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.
8. Tempered-Water Setting: 105 deg F.
9. Tempered-Water Design Flow Rate: 1.5 gpm, or as indicated on the Drawings.

2.4 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 (DN 65) and larger.
3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.

4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
    a. Strainers NPS 2 (DN 50) and Smaller: 0.033 inch (0.84 mm) or 0.062 inch (1.57 mm).
    b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.045 inch (1.14 mm).
6. Drain: Factory-installed, hose-end ball-type drain valve.

2.5 HOSE BIBBS

A. Hose Bibbs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Watts Drainage Products Inc.
    e. Chicago Faucet.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig (860 kPa).
8. Vacuum Breaker: Integral, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Finished Rooms: Operating key.
13. Include operating key with each operating-key hose bibb.
14. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.6 WALL HYDRANTS

A. Exterior Nonfreeze Wall Hydrants:

1. Basis of Design Product: Subject to compliance with requirements, provide Jay R. Smith Figure Number 5509QT, or comparable product by one of the following:
    a. Josam.
    b. Watts Drainage Products Inc.
    c. Zurn Plumbing Products.
2. Standard: ASME A112.21.3M for exposed-outlet, self-draining non-freeze wall hydrants.
3. Pressure Rating: 125 psig (860 kPa).
4. Operation: Loose key, Quarter turn.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 (DN 20), female/NPS 1” (DN 25) male.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Outlet: Exposed, manual drain type, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
9. Nozzle and Wall-Plate Finish: Nickle Bronze Face.
10. Operating Keys(s): Two with each wall hydrant.
11. Recessed Box: Stainless steel with full 180° cover opening.
12. For dual temperature, hot and cold provide Jay R. Smith figure number 5560QT.

B. Interior Cold-Water Wall Hydrants:

1. Basis of Design Product: Subject to compliance with requirements, provide Josam Hydrasan I, Model 71020, or comparable product by one of the following:
    a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    b. Tyler Pipe; Wade Div.
    c. Watts Drainage Products Inc.
    d. Woodford Manufacturing Company.
    e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.21.3M for concealed or exposed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig (860 kPa).
4. Operation: Loose key.
5. Casings and Operating Rods: Of length required to match wall thickness. Include wall clamps.
6. Inlets: NPS 3/4 female, or NPS 1 male (DN 20 or DN 25).
7. Outlet: Concealed.
8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: Polished nickel bronze.
10. Vacuum Breaker: Nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052 and with garden-hose thread complying with ASME B1.20.7 on outlet.
11. Operating Keys(s): Two with each wall hydrant.

2.7 NON-FREEZE POST HYDRANTS

A. Nonfreeze Post Hydrants:

1. Basis of Design Product: Subject to compliance with requirements, provide Jay R. Smith model 5909, or comparable product by one of the following:
    a. Josam
    b. Watts Drainage Products Inc.
    c. Zurn Plumbing Products.
2. Standard: ASME A112.21.3M
3. Pressure Rating: 125 psig (860 kPa).
4. Operation: Locking Lever Handle.
5. Casing and Operating Rod: Of length required to for valve body bury depth below frost line.
6. Inlet: NPS 3/4 (DN 20), female/NPS 1” (DN 25) male.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Outlet: Exposed, manual drain type, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
9. Valve Body: Self draining, buried below frost line to prevent freezing.

2.8 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy.
5. Ball: Stainless steel.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.9 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Josam Company.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Watts Drainage Products.
   e. Zurn Plumbing Products.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.10 AIR VENTS

A. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig (1035-kPa) minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 (DN 15) minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.12 OUTLET BOXES:

A. CLOTHES WASHER OUTLET BOXES

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Acorn Engineering Company.
   b. Guy Gray Manufacturing Co., Inc.
   c. Symmons Industries, Inc.
   d. Watts Industries, Inc.; Water Products Div.
   e. Zurn Plumbing Products Group; Light Commercial Operation.

2. Mounting: Recessed.
3. Material and Finish: Enameled-steel or epoxy-painted-steelbox and faceplate.
4. Faucet: Combination, valved fitting or separate hot and cold water, valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Supply Shutoff Fittings: NPS ½ (DN 15) glove, or ball valves and NPS ½ (DN 15) copper, water tubing.
6. Drain: NPS 2 (DN 50) standpipe and P-trap for direct waste connection to drainage piping.
7. Inlet Hoses: Two 60-inch (1500 mm) long, rubber household clothes washer inlet hoses with female, garden-hose-thread coupling. Include rubber washers.
8. Drain Hose: One 48-inch (1200 mm) long, rubber household clothes washer drain hose with hooked end.

B. ICEMAKER OUTLET BOXES:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Acorn Engineering Company.
   b. IPS Corporation.
   c. LSP Products Group, Inc.
   d. Oatey.
   e. Plastic Oddities; a division of Diverse Corporate Technologies.

2. Mounting: Recessed.
3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS ½ (DN 15) or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS ½ (DN 15) globe or ball valve and NPS ½ (DN 15) copper, water tubing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install water regulators with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.
D. Install water control valves with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.
E. Install balancing valves in locations where they can easily be adjusted.
F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and water regulators if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified.

G. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve, and pump.
H. Install outlet boxes recessed in wall. Install 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."

I. Install water hammer arresters in water piping according to PDI-WH 201.
J. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Reduced-pressure-principle backflow preventers.

3. Double-check backflow-prevention assemblies.
4. Reduced-pressure-detector, fire-protection backflow-preventer assemblies.
5. Water pressure-reducing valves.
6. Calibrated balancing valves.
7. Primary, thermostatic, water mixing valves.
8. Primary water tempering valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.
B. Set field-adjustable flow set points of balancing valves.
C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following for soil, waste, and vent piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.
3. Encasement for underground metal piping.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. LLDPE: Linear, low-density polyethylene plastic.

D. NBR: Acrylonitrile-butadiene rubber.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

G. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: (Type DWV) ASTM D 2665, drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

B. Solvent Cement and Adhesive Primer:

1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 HUB-LESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.

C. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Heavy-Duty, Husky Type, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

a. Available Manufacturers:
1) ANACO.
2) Clamp-All Corp.
3) Ideal Div.; Stant Corp.
4) Mission Rubber Co.
5) Tyler Pipe; Soil Pipe Div.
6) Charlott.

D. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:

a. ANACO.

2.5 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
2. Copper Condensate Drain Piping: Type L, drawn copper tubing, wrought copper fittings and soldered joints.

2.6 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Fernco, Inc.
b. Logan Clay Products Company (The).
c. NDS, Inc.
d. Plastic Oddities, Inc.

2. Sleeve Materials:

a. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
b. For cast iron soil pipes: ASTM C564 rubber.
c. For dissimilar pipes: ASTM D 1460, elastomeric or rubber sleeve with full length, corrosion-resistant outer shield and corrosion-resistant metal tension band and tightening mechanism on each end.

B. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers:

a. EBAA Iron Sales, Inc.
b. Romac Industries, Inc.
c. Star Pipe Products; Star Fittings Div.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground, soil and waste piping shall be one of the following:

1. Hubless cast iron soil pipe and fittings; heavy duty (husky) shielded stainless steel couplings and hubless coupling joints.

C. Aboveground, vent piping shall be one of the following:

1. Hubless cast iron soil pipe and fittings; heavy duty (husky) shielded stainless steel couplings and hubless coupling joints.
2. Solid wall, Sewer and Drain Series, Schedule 40, PVC pipe; PVC socket fittings; and solvent-cemented joints.

D. Underground, soil, waste, and vent piping NPS 6 and smaller shall be the following:

1. Solid wall, Sewer and Drain Series, Schedule 40, PVC pipe; PVC socket fittings; and solvent-cemented joints except for kitchen.
2. Service class cast iron soil piping with gasketed or caulked joints.

F. All Condensate Drain Piping: Shall be one of the following:

1. Type L, drawn copper tubing with wrought copper fittings and soldered joints.
2. Solid wall PVC pipe.

3.3 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

C. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and fittings Handbook" Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

D. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

E. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

F. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

G. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

H. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

I. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

J. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

K. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

L. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

M. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

C. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

D. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 VALVE INSTALLATION

A. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

B. Backwater Valves: Install backwater valves in piping subject to sewage backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated. Provide full-sized manhole to grade/finished floor.
2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Backwater valve are specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs according to the following:
   a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.

F. Install supports for vertical cast-iron soil piping at each floor and every 15 feet (4.5 m).

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
6. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.

H. Install supports for vertical copper tubing every 10 feet (3 m).

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Trench drains.
5. Roof flashing assemblies.
6. Through-penetration firestop assemblies.
7. Miscellaneous sanitary drainage piping specialties.
8. Flashing materials.

B. Related Sections include the following:

1. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:

1. Drains.
2. Backwater valves.
3. Solids Interceptors.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.14.1.
3. Size: Same as connected piping.
4. Body: Cast iron.
5. Cover: Cast iron with bolted access check valve.
6. End Connections: Hubless.
7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Horizontal, PVC Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Rectorseal or as approved equal.

2. Size: Same as connected piping.
3. Body: PVC.
4. Cover: PVC with screwed access to check valve.
5. End Connections: Glued.
6. Type Check Valve: Removable, PVC, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
7. Extension: PVC, soil-pipe extension to field-installed cleanout at floor.

C. Drain-Outlet Backwater Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company; Josam Div.
    b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
    c. Watts Drainage Products Inc.
    d. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Size: Same as floor drain outlet.
4. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
5. Check Valve: Removable ball float.
6. Inlet: Threaded.
7. Outlet: Threaded or spigot.

2.2 CLEANOUTS

A. Exposed Metal Cleanouts – Unfinished areas:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith 4228 Series or a comparable product by one of the following:
    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
    g. Josam Company; Blucher-Josam Div.
2. Standard: ASME A112.3.1 for stainless steel for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Stainless-steel tee with side cleanout as required to match connected piping.
5. Closure: Countersunk brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith Series 4188C (terrazzo-recessed); Series 4168C (composition tile – recessed); Series 4048C (ceramic tile – non-recessed); and Series 4026C-Y (carpet with clean-out marker); or a comparable product by one of the following:
    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Tyler Pipe; Wade Div.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group.
2. Standard: ASME A112.36.2M for cast-iron soil pipe with cast-iron ferrule cleanout.
3. Size: Same as connected branch.
4. Type: Cast-iron soil pipe with cast-iron ferrule.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round, Square, or as determined by floor type.
12. Flashing Flange: Required.
13. Flashing Clamp: Required.
14. Top Loading Classification: Heavy Duty.

15. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Wall Cleanouts:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith Series 5432 (unfinished areas, Series 4558 (plaster/drywall) and Series 4532 (tile/CMU) or a comparable product by one of the following:

   a. Josam Company; Josam Div.
   b. Watts Drainage Products Inc.
   c. Zurn Plumbing Products Group; Specification Drainage Operation.
   d. Wade

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Square, stainless-steel wall-installation frame and cover. Refer to Series type.

2.3 FLOOR DRAINS

A. Cast-Iron Floor Drains – FD-A: (Mechanical Equipment Rooms)

1. Basis-of-Design Product: Subject to compliance with requirements, provide J. R. Smith Series 2230 or a comparable product by one of the following:

   a. Josam Company; Josam Div.
   b. Watts Drainage Products
   c. Tyler Pipe; Wade Div.
   d. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Not required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Sediment Bucket: Slotted sediment bucket.
12. Top or Strainer Material: Galvanized cast iron.
13. Top Shape: Round.
14. Dimensions of Top or Strainer: 12” Round**.**
15. Top Loading Classification: Medium Duty.
16. Funnel: Required, where receiving piped waste.
17. Inlet Fitting: Gray iron, with threaded inlet and threaded or no hub outlet.
18. Trap Material: Cast iron.
19. Trap Pattern: Deep-seal P-trap.
20. Trap Features: Trap primary connect where indicated on the drawing provide Trap Guard if not trap primed.

B. Cast-Iron Floor Drains – FD-B:

1. Basis-of-Design Product: Subject to compliance with requirements, provide J. R. Smith Series 2005 or a comparable product by one of the following:

   a. Josam Company; Josam Div.
   b. Wade
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Not required.
11. Sediment Bucket: Not required.
12. Top or Strainer Material: Nickel bronze.
13. Top of Body and Strainer Finish: Nickel bronze.
14. Top Shape: Heelproof round; or square where installed in tile floors.
15. Dimensions of Top or Strainer: 3” outlet/6” strainer, 4” outlet 8” strainer
16. Funnel: Not required.
17. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet.
18. Trap Material: Not required.
19. Trap Pattern: Deep-seal P-trap.
20. Trap Features: Trap primer where indicated, Trap Guard where not trap primed.

2.4 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide Thaler SJ-25-A products or equal:

B. Description: EPDM base seal and aluminum skirt extending at least 18 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting with removable cap. Provide 20-year warranty against leaks, condensation, and defects in materials and/or manufacturing.

2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. ProSet Systems Inc.

2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

2.6 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Backwater Valve Open Drains – (OHD):

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.
3. Open hub drain shall be Josam 67100A Series coated cast iron with ball float, Backwater Valve, or comparable product of J.R. Smith, Zurn, or Wade.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
   a. NPS 2 (DN 50): 4-inch- (100-mm-) minimum water seal.
   b. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.

C. Floor-Drain, Trap-Guard:

1. Description: Trap guards shall be ProVent Systems, Pro Set trap guard, ASSE 1072 approved test for ANSI / ASME A11.2.6.3 drains.
2. Size: Same as floor drain outlet. Refer to manufacture for sizing.

D. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches (51 mm) above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

F. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Expansion Joints:

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.7 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm) thickness.

2. Vent Pipe Flashing: 8 oz./sq. ft. (2.5 kg/sq. m or 0.27-mm) thickness.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
4. Locate at base of each vertical soil and waste stack.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

   a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
   b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
   c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

G. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

H. Assemble and install ASME A112.3.1, stainless-steel channel drainage systems according to ASME A112.3.1. Install on support devices so that top will be flush with surface.

I. Assemble non-ASME A112.3.1, stainless-steel channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

J. Assemble FRP channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

K. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

L. Install fixture air-admittance valves on fixture drain piping.

M. Install stack air-admittance valves at top of stack vent and vent stack piping.

N. Install air-admittance-valve wall boxes recessed in wall.

O. The Roofing Contractor shall install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

P. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

Q. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

R. Assemble open drain fittings and install with top of hub 2 inches (51 mm) above floor.

S. Install deep-seal traps on floor drains and other waste outlets.

T. Install floor-drain, trap guard on inlet to floor drains.

U. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

V. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

W. Install vent caps on each vent pipe passing through roof.

X. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.

Y. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

Z. Install wood-blocking reinforcement for wall-mounting-type specialties.

AA. Install traps with trap guards on plumbing specialty drain outlets.

BB. Install Trap Guards on all drains (open hub drains, floor drains, etc.) not served by a trap primer. Trap priming is not required for drains with Trap Guards installed.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Solids interceptors.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 14 13 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following storm drainage piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.

B. Related Sections include the following:

1. Division 22 Section "Sump Pumps."

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. LLDPE: Linear, low-density polyethylene plastic.

C. PE: Polyethylene plastic.

D. PVC: Polyvinyl chloride plastic.

E. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water (30 kPa).
2. Storm Drainage, Force-Main Piping: 50 psig (345 kPa).

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. Solvent Cement and Adhesive Primer:

1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 HUBLESS CAST IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

a. Available Manufacturers:
1) ANACO.
2) Clamp-All Corp.
3) Ideal Div.; Stant Corp.
4) Mission Rubber Co.
5) Tyler Pipe; Soil Pipe Div.
6) Charlotte.

C. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:

a. ANACO, or equal.

2.5 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast-copper or ASME B16.29, wrought-copper, solder-joint fittings.

B. Hard Copper Tube: ASTM B 88, Types L and M (ASTM B 88M, Types B and C), water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

C. Soft Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, annealed temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2.6 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Dallas Specialty & Mfg. Co.
b. Fernco, Inc.
c. Logan Clay Products Company (The).

2. Sleeve Materials:

a. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
b. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.
b. Mission Rubber Co.

C. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.

1. Manufacturers:

   a. Cascade Waterworks Mfg. Co.
   b. Dresser, Inc.; DMD Div.
   c. EBAA Iron Sales, Inc.
   d. Ford Meter Box Company, Inc. (The); Pipe Products Div.
   e. JCM Industries, Inc.
   f. Romac Industries, Inc.
   g. Smith-Blair, Inc.
   h. Viking Johnson.

2. Gasket Material: Natural or synthetic rubber.
3. Metal Component Finish: Corrosion-resistant coating or material.

D. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers:

   a. EBAA Iron Sales, Inc.
   b. Romac Industries, Inc.
   c. Star Pipe Products; Star Fittings Div.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground storm drainage piping shall be the following:

1. Hubless cast iron soil pipe and fittings; heavy duty (husky) shielded stainless steel couplings and hubless coupling joints.
2. Dissimilar pipe material couplings: Rigid, unshielded non-pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

C. Underground storm drainage piping shall be the following:

1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

D. Aboveground storm drainage force mains shall be the following:

1. Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.

E. Condensate drain piping shall be one of the following.

1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Copper DWV pipe and fittings

3.3 PIPING INSTALLATION

A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Utility Drainage Piping."

B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Storm Drainage Piping Specialties."

D. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

E. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

F. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

G. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

H. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:

1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 2 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

I. Install force mains at elevations indicated.

J. Install PVC storm drainage piping according to ASTM D 2665.

K. Install underground PVC storm drainage piping according to ASTM D 2321.

L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

M. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Common Work Results for Plumbing."

N. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Common Work Results for Plumbing."

O. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Common Work Results for Plumbing."

P. Install cast iron storm drainage piping for all above ground locations. \

Q. Provide 3” minimum back water valve with 3”x4” increaser and 12” high, 4” diameter standpipe for condensate collection to storm water mains. Provide no hub drains with back water valves for collecting condensate at individual terminal units. Provide funnel above back water valve.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

C. Hubless cast iron soil piping coupled joints; Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and fittings Handbook" for hubless-coupling joints.

D. Soldered joints: Use ASTM B 813, water flushable, lead-free flux; ASTM B32, lead-free alloy solder; and ASTM B828 procedure, unless otherwise indicated.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves: Install shutoff valve on each sump pump discharge.

1. Install full-port ball valve for piping NPS 2 (DN 50) and smaller.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sump pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
2. Install backwater valves in accessible locations.
3. Backwater valve are specified in Division 22 Section "Storm Drainage Piping Specialties."
4. Condensate drains connected to storm water piping. Provide access door where installed in walls. Locate back water valves as high as possible where receiving condensate drains. Provide 12" high standpipe and air break for condensate collection to storm water piping. Provide funnels for no hub drains serving individual terminal units.

3.6 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:
   a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
6. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).

F. Install supports for vertical cast-iron soil piping at each floor and every 15 feet (4.5 m).

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
6. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.

H. Install supports for vertical copper tubing every 10 feet (3 m).

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

D. Connect force-main piping to the following:

1. Sump Pumps: To sump pump discharge.

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

SECTION 22 14 23 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.
4. Backwater valves.
5. Through-penetration firestop assemblies.
6. Flashing materials.
7. Air gap fitting.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

A. Cast-Iron, Large-Sump, General-Purpose Roof Drains: RD

1. Manufacturers: Basis of Design Product: Subject to compliance with requirements, provide Jay R. Smith Series 1010 or comparable product by one of the following:

   a. Josam Company.
   b. Tyler Pipe; Wade Div.
   c. Zurn Plumbing Products.

2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 15-1/4” diameter.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Flow-Control Weirs: Not required.
7. Outlet: Bottom, caulk outlet.
8. Extension Collars: Required.
9. Underdeck Clamp: Required.
10. Expansion Joint: Not required.
11. Sump Receiver Plate: Required.
12. Dome Material: Galvanized cast iron.
13. Perforated Gravel Guard: Stainless Steel.

14. Vandal-Proof Dome: Required.
15. Water Dam: Not required.

B. Cast-Iron, Overflow Drains: OD

1. Manufacturers: Basis of Design Product: Subject to compliance with requirements, provide Jay R. Smith Series 1070 or comparable product by one of the following:

   a. Josam Company.
   b. Tyler Pipe; Wade Div.
   c. Zurn Plumbing Products.

2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 15-1/4" diameter.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Flow-Control Weirs: Not required.
7. Outlet: Bottom, caulk outlet.
8. Extension Collars: Required.
9. Underdeck Clamp: Required.
10. Expansion Joint: Not required.
11. Sump Receiver Plate: Required.
12. Dome Material: Galvanized cast iron.
13. Perforated Gravel Guard: Not Required.
14. Vandal-Proof Dome: Required.
15. Water Dam: Not required.
16. Overflow Standpipe: Required. Cast iron-field cut to proper height.

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Conductor Nozzles:

1. Description: Nickle bronze body with threaded inlet and nickle bronze wall flange with mounting holes and bird screen.
2. Size: Same as connected conductor.
3. JR Smith 1770T or equal of Josam, Zurn or Watts.

B. Downspout Adaptors:

1. Description: Manufactured, gray-iron casting, for attaching to horizontal-outlet, parapet roof drain and to exterior, sheet metal downspout.
2. Size: Inlet size to match parapet drain outlet.

C. Downspout Boots:

1. Description: Manufactured, heavy duty 14-gauge type 304 stainless steel, with strap or ears for attaching to building; NPS 4 (DN 100) outlet; and shop-applied powder coating.
2. Manufacturers: Basis of design Piedmont Model SV or as approved equal
3. Size: Inlet size to match downspout and NPS 4 (DN 100) outlet.
4. Color Custom color selected by architect.
5. Cleanout: Provide cleanout.

2.3 CLEANOUTS

A. Floor Cleanouts:

1. Basis of Design Product: Subject to the compliance with requirements, provide Jay R. Smith Series 4188C (terrazzo-recessed), Series 4168C (composition tile –recessed), Series 4048C

(Ceramic tile –Non-recessed), and Series 40266-Y (carpet with clean-out marker0 or comparable products of one of the following:

a. Josam Company.
b. Smith, Jay R. Mfg. Co.
c. Mifab, Inc..
d. Zurn Plumbing Products Group; Specification Drainage Operation.
e. Wade.
f. Watts Water Technologies, Inc.

2. Standard: ASME A112.36.2M, cast iron soil pipe with cast iron ferrule.
3. Size: Same as connected branch.
4. Type: Cast iron soil pipe with cast iron ferrule.
5. Body or Ferrule Material: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round or square as determined by floor type.
12. Top-Loading Classification: Light Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

B. Test Tees :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Josam Company.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.
d. Watts Water Technologies, Inc.
e. Zurn Plumbing Products Group; Specification Drainage Operation.
f. Wade.

2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
3. Size: Same as connected drainage piping.
4. Body Material: Cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure Plug: Countersunk.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

C. Wall Cleanouts:

1. Basis of Design Product: Subject to compliance with requirements, provide Jay R. Smith Series 5432 (unfinished areas), Series 4558 plaster/drywall) and Series 4532 (tile and CMU) or comparable product of one of the following:

a. Josam Company.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.
d. Wade.
e. Watts Water Technologies, Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
3. Size: Same as connected drainage piping.
4. Body Material: Hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure: Countersunk brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw. Refer to Series type.
8. Wall Access: Square stainless steel wall installation frame and cover.

2.4 BACKWATER VALVES

A. Cast-Iron, Horizontal Backwater Valves :

1. Basis of Design Product: Subject to compliance with requirements, provide Jay R. Smith Series 7022S or comparable product of one of the following:

   a. Josam Company.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.
   d. Watts Water Technologies, Inc.
   e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.14.1, for backwater valves.
3. Size: Same as connected piping.
4. Body Material: Cast iron.
5. Cover: Cast iron with bolted access check valve.
6. End Connections: hubless.
7. Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed.
8. Extension: ASTM A 74, Service class; full-size, cast-iron soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Horizontal, PVC Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Rectorseal or as approved equal.

2. Size: Same as connected piping.
3. Body: PVC.
4. Cover: PVC with screwed access to check valve.
5. End Connections: Glued.
6. Type Check Valve: Removable, PVC, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
7. Extension: PVC, soil-pipe extension to field-installed cleanout at floor.

C. Cast-Iron, Drain-Outlet Backwater Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith 7080 Series or comparable product by one of the following:

   a. Josam Company.
   b. Smith, Jay R. Mfg. Co.
   c. Watts Water Technologies, Inc.
   d. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Size: Same as floor drain or no hub outlet.
3. Body Material: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
4. Check Valve: Removable ball float.
5. Inlet: Threaded.
6. Outlet: Threaded or spigot.
7. Air Gap: Provide air gap fitting where receiving condensate in a storm water riser.

2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

   a. ProSet Systems Inc.

2. Standard: ASTM E 814, for through-penetration firestop assemblies.
3. Certification and Listing: Intertek Testing Service NA for through-penetration firestop assemblies.
4. Size: Same as connected pipe.
5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
7. Special Coating: Corrosion resistant on interior of fittings.

2.6 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, 1203/sq.ft.

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40 mil minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

2.7 AIR GAP FITTING: Threaded or Spigot Outlet JR Smith 3951T or 3955S or equal of Josam, Watts, Zurn or Wade.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07 Sections.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.
3. Position roof drains for easy access and maintenance.
4. Coordinate installation with the Roofing Contractor.

B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.

C. Install downspout boots at grade with top a minimum of 18 inches (Refer to Architectural Drawings) above grade. Secure to building wall.

D. Install conductor nozzles at exposed end of conductors where they spill onto grade.

E. Install cleanouts in aboveground piping and building drain piping according to the International Plumbing Code, and where indicated.

1. Use cleanouts the same size as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.

2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
4. Locate cleanouts at base of each vertical soil and waste stack.

F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

H. Install horizontal backwater valves in floor with cover flush with floor.

I. Install drain-outlet backwater valves in outlet of drains.

J. Install test tees in vertical conductors and near floor.

K. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

L. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.

M. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

N. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.

O. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

P. Provide back water valves where collecting condensate drains. Provide 12” high stand pipes Fittings where connected to storm water risers. Provide access door at back water valves concealed in chases. Provide funnels where installed at floor level.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. (30-kg/sq. m) lead sheets. Solder joints of 4.0-lb/sq. ft. (20-kg/sq. m) lead sheets, 0.0625-inch (1.6-mm) thickness or thinner.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches (250 mm) and with skirt or flange extending at least 8 inches (200 mm) around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 14 29 - SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Submersible sump pumps and controls.

B. Related Section:

1. Division 22 Section "Sanitary Sewerage Pumps" for effluent and sewage pumps.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SUMP PUMPS

A. Submersible, Fixed-Position, Single-Seal Sump Pumps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Barnes; Crane Pumps & Systems.
   b. Bell & Gossett Domestic Pump; ITT Corporation.
   c. Flo Fab inc.
   d. Goulds Pumps; ITT Corporation.
   e. Grundfos Pumps Corp.
   f. Liberty Pumps.
   g. Little Giant Pump Co.
   h. Pentair Pump Group; Myers.
   i. Stancor, Inc.
   j. Sta-Rite Industries, Inc.
   k. Weil Pump Company, Inc.
   l. Zoeller Company.

2. Description: Factory-assembled and -tested sump-pump unit.
3. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
4. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
5. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron semiopen design for clear wastewater handling, and keyed and secured to shaft.
6. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
7. Seal: Mechanical.
8. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.

   a. Motor Housing Fluid: Oil.

9. Controls:

   a. Enclosure: NEMA 250, Type 4X; wall-mounted.
   b. Switch Type: Mechanical-float type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
   c. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, mercury-float, or pressure switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.
   d. Oil Control and Monitor System: The oil control system shall meet the requirements of ASME A17.1 allowing water to be pumped from elevator pits and preventing oil from being pumped.

10. Control-Interface Features:

    a. Remote Alarm Contacts: For remote alarm interface with the building control and monitoring system.
    b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
       1) On-off status of pump.
       2) Alarm status.

11. Control System:

    a. The Control System shall have a local and remote audio and visual warning system for hydraulic oil spill alert, high liquid condition, and high amperage. Provide a remote alarm contact and interlock to the Building Energy Management System. Coordinate requirements with EMS contractor.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation and filling are specified in Division 31 Section "Earth Moving."

3.2 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.3 INSTALLATION

A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

3.4 CONNECTIONS

A. Comply with requirements for piping specified in Division 22 Section "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Pumps and controls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust control set points.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following conventional plumbing fixtures and related components:

1. Lavatory Faucets.
2. Sink Faucets.
3. Protective shielding guards.
4. Fixture supports.
5. Lavatories.
6. Sinks.
7. Sinks provided under another division.

B. Related Sections include the following:

1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
2. Division 22 Section "Drinking Fountains and Water Coolers."

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

F. FRP: Fiberglass-reinforced plastic.

G. PMMA: Polymethyl methacrylate (acrylic) plastic.

H. PVC: Polyvinyl chloride plastic.

I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes,

dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, cast-iron fixtures: ASME A112.19.1M.
2. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
3. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
4. Vitreous-China Fixtures: ASME A112.19.2M.
5. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME.A112.18.3M.
2. Faucets: ASME A112.18.1.
3. Hose-Connection Vacuum Breakers: ASSE 1011.
4. Hose-Coupling Threads: ASME B1.20.7.
5. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
6. NSF Potable-Water Materials: NSF 61.
7. Pipe Threads: ASME B1.20.1.
8. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
9. Supply Fittings: ASME A112.18.1.
10. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for shower faucets:

1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
3. Faucets: ASME A112.18.1.
4. Hand-Held Showers: ASSE 1014.
5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
6. Hose Coupling Threads: ASME B1.20.7.
7. Manual-Control Antiscald Faucets: ASTM F 444.

8. Pipe Threads: ASME B1.20.1.
9. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
10. Thermostatic-Control Antiscald Faucets: ASTM F444 and ASSE 1016.

J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Dishwasher Air-Gap Fittings: ASSE 1021.
4. Manual-Operation Flushometers: ASSE 1037.
5. Plastic Tubular Fittings: ASTM F 409.
6. Brass Waste Fittings: ASME A112.18.2.
7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Disposers: ASSE 1008 and UL 430.
2. Dishwasher Air Gap Fittings: ASSE 1021.
3. Flexible Water Connectors: ASME A112.18.6.
4. Floor Drains: ASME A112.6.3.
5. Grab Bars: ASTM F 446.
6. Hose Coupling Threads: ASME B1.20.7.
7. Off-Floor Fixture Supports: ASME A112.6.1M.
8. Pipe Threads: ASME B1.20.1.
9. Plastic Toilet Seats: ANSI Z124.5.
10. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 2 of each type.
4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
5. Waterless Urinal Cartridges: Equal to 10 percent of amount of each type installed.
6. Toilet Seats: Equal to 5% of amount of each type installed.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

A. Lavatory Faucet – LF-1 (ADA): automatic counter-mounted sensor solid-brass valve.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick B-995 or comparable product by one of the following:

   a. Sloan

   b. American Standard
   c. T&S Brass
   d. Zurn
   e. Moen

2. Standards: ASME A112.18.1/CSA B125.1, ADA ANSI/ICC A117.1, MSF/ANSI 61 and 372.
3. General: Include faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
4. Body Type: One hole.
5. Body Material: Commercial, solid brass.
6. Finish: Polished chrome plate.
7. Maximum Flow Rate: 0.5 gpm.
8. Mounting Type: Deck, concealed.
9. Operation: Infared sensor, electronic, 12 second operation.
10. Spout: Rigid type, 5” minimum center to center, angled water outlet, pressure compensating laminar flow non-aerating outlet.
11. Inlets: NPS ½”
12. Power:

    a. Base Bid: Hard wired, 120 VAC, 60 HZ

2.2 SINK FAUCETS

A. Sink Faucets, SF-2 (ADA):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Chicago Faucet Model 786-GN8AE73-369XKAB or a comparable product by one of the following:

    a. American Standard
    b. Kohler Co.
    c. Moen, Inc.
    d. T&SD Brass and Bronze Works, Inc.
    e. Zurn Plumbing Products Group; Commercial brass Operation.

2. Description: Classroom faucet, three-hole fixture. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

    a. Body Material: Commercial, solid brass.
    b. Finish: Polished chrome plate.
    c. Maximum Flow Rate: 1.0 gpm unless otherwise indicated.
    d. Mixing Valve: Two-lever handle.
    e. Backflow Protection Device for Hose Outlet: Not required.
    f. Centers: 8 inches (203 mm).
    g. Mounting: Deck, concealed.
    h. Handle(s): Lever.
    i. Inlet(s): NPS 1/2 (DN 15) male shank.
    j. Spout Type: 8” field adjustable 120 degree restricted ridged/swing gooseneck.
    k. Spout Outlet: Vandal-proof Laminar flow non-aerating outlet
    l. Vacuum Breaker: Not required.
    m. Operation: Compression, manual.
    n. Drain: Grid.

2.3 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide Trubro Inc. Lav Guard 2 ADA compliant under sink protection or a comparable product by one of the following:

    a. Engineered Brass Co.
    b. McGuire Manufacturing Co., Inc.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.4 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. Wade
3. Smith, Jay R. Mfg. Co.
4. Watts Drainage products

B. Lavatory Supports:

1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

2.5 LAVATORIES

A. Lavatories, P-3A (ADA):

1. Manufacturers: Basis of Design Product: Subject to Compliance with requirements, provide Kohler Brazn K-21056 undermount Lavatory, or a comparable product of one of the following:

a. Sloan
b. American Standard
c. Description: Kohler 16-1/4" square undermount bathroom sink. Automated sensor faucet. Ssensor operated foam soap dispenser. Sink design to be ADA compliant and IAPMO certified. Supplied with angle brackets or enclosure.

d. Type: Wall hung, concealed arm support
e. Lavatory Size: 16 x 16 inches.
f. Faucet Hole Punching: single hole, to match lavatory
g. Faucet Hole Location: Top.
h. Color: By Architect.
i. Faucet: LF-3.
j. Supplies: NPS 3/8 (DN 10) chrome-plated copper with loose key stops. Chicago Faucet Model 1006-ABCP with supply risers.
k. Drain: Grid, Chicago Faucet Fitting No. 327, 17 ga. tailpiece.
   1) Location: centered of bowl.

l. Drain Piping: ADA offset, NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40) chrome-plated, cast-brass P-trap; NPS 1-1/2 (DN 40), 17 ga thick tubular brass waste to wall; and wall escutcheon.

m. Protective Shielding Guards: Required
n. Height: ADA height. Refer to Architectural drawings

2.6 SINKS

A. Sinks, P-5:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Just Manufacturing SLF-ADA-2131-A-GR, or a comparable product by one of the following:

a. Elkay.
b. Advance Tabco.

2. Description: One-compartment, counter-mounting, self rimming, stainless-steel commercial sink fully undercoated to damper sound and prevent condensation.

a. Overall Dimensions: 31" x 21".
b. Metal Thickness: 18 gauge, Type 304 (18-8) stainless steel.

c. Compartment: Single
   1) Dimensions: 28” x 16” x 5-1/2” deep.
   2) Drain: Grid with NPS 1-1/2 (DN 40) tailpiece.
      a) Location: Near back of compartment.
   3) Overflow Drain:
      a) Location: Back of compartment.

d. Faucet(s): SF-2.
   1) Number Required: One.
   2) Mounting: Deck.

e. Supplies: NPS 1/2 (DN 15) chrome-plated copper with loose-key, angle service stops. Chicago Model 1006-ABCP with supply risers.

f. Drain Piping: NPS 1-1/2 (DN 40) chrome-plated, cast-brass P trap with clean-out; 0.045-inch (1.1-mm) thick tubular brass waste to wall; and wall escutcheons.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

   1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
   2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
   3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install counter-mounting fixtures in and attached to casework.

G. Install fixtures level and plumb according to roughing-in drawings.

H. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

   1. Exception: Use ball valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

K. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

L. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

M. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

N. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

O. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

P. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Escutcheons for Plumbing Piping."

Q. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust disposers and controls. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

D. Replace washers and seals of leaking and dripping faucets and stops.

E. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 47 00 - WATER COOLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following water coolers and related components:

1. Pressure water coolers.
2. Fixture supports.

1.3 DEFINITIONS

A. Accessible Drinking Fountain or Water Cooler: Fixture that can be approached and used by people with disabilities.

B. Cast Polymer: Dense, cast-filled-polymer plastic.

C. Fitting: Device that controls flow of water into or out of fixture.

D. Fixture: Water cooler unless one is specifically indicated.

E. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

F. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.

1.4 SUBMITTALS

A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for fixtures for people with disabilities.

C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

D. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.

E. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS

A. Water Coolers, P-6 (Accessible with Bottle Filler):

1. Manufacturers: Basis of Design Product: Subject to compliance with requirements, provide Elkay ezH2O LZS8WSVRSK or a comparable product by one of the following:

   a. Halsey Taylor

   b. Haws Corporation.
   c. Oasis Corporation.

2. Description: Accessible, single bowl, with bubbler and bottle filler, wall-mounted water cooler.

   a. Cabinet: single level with attached cabinet made from all stainless steel.
   b. Bubbler: One, with adjustable stream regulator.
   c. Control: Front and side bubbler push bar with Electronic Bottle Filler Sensors.
   d. Supply: NPS 3/8 (DN 10) with ball, gate, or globe valve.
   e. Drain(s): Grid with NPS 1-1/4 (DN 32) minimum horizontal waste and trap complying with ASME A112.18.1.
   f. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, R-134A refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
      1) Capacity: 8 gph (0.0084 L/s) of 50 deg F (10 deg C) cooled water from 80 deg F (27 deg C) inlet water and 90 deg F (32 deg C) ambient air temperature.
      2) Electrical Characteristics: 120-V ac; single phase; 60 Hz.

   g. Support: Type I, water cooler carrier for each. J. R. Smith Model 0800. Refer to "Fixture Supports" Article.

   h. Filter: With filter

   i. Bottle Filler: Yes.

3. Standards: ADA, ICC A 117.1, ASME A 112.19.3, NSF/ANSI 61 and 372, UL 399.

2.2 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Co.
2. Smith, Jay R. Mfg. Co.
3. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
4. Wade.
5. Zurn Plumbing Products Group.

B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.

1. Type I: Hanger type carrier with two vertical uprights.
2. Supports for accessible fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.

B. Examine walls and floors for suitable conditions where fixtures are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.

B. Use mounting frames for recessed water coolers, unless otherwise indicated.

C. Set freestanding and pedestal drinking fountains on floor.

D. Set remote water coolers on floor, unless otherwise indicated.

E. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.

B. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.

C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

E. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section "Escutcheons for Plumbing Piping."

F. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

G. Install mounting frames affixed to building construction and attach recessed, wall-mounted water coolers to mounting frames.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.

1. Remove and replace malfunctioning units and retest as specified above.
2. Report test results in writing.

3.6 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust water cooler temperature settings.

3.7 CLEANING

A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

3.8 WARRANTY

A. Provide two (2) year warranty for water coolers and a five (5) year parts, labor and refrigerant warranty for the refrigeration system.

B. Warranty shall start at substantial completion.

END OF SECTION

SECTION 22 63 23 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.
6. Service meters.
7. Concrete bases.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig (690 kPa) minimum unless otherwise indicated.
2. Service Regulators: 100 psig (690 kPa) minimum unless otherwise indicated.
3. Minimum Operating Pressure of Service Meter: 5 psig (34.5 kPa) –coordinate with PECO.

B. Natural-Gas System Pressure within Buildings: More than 0.5 psig (3.45 kPa) but not more than 2 psig (13.8 kPa).

C. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig (3.45 kPa) but not more than 2 psig (13.8 kPa), and is reduced to secondary pressure of 0.5 psig (3.45 kPa) or less.

1.5 SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Corrugated, stainless-steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Dielectric fittings.

B. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

C. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

D. Welding certificates.

E. Field quality-control reports.

F. Operation and Maintenance Data: For motorized gas valves and pressure regulator to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.8 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Architect and Owner no fewer than seven days in advance of proposed interruption of natural-gas service.

2. Do not proceed with interruption of natural-gas service without Architect's and Owner's written permission.
3. Disruptions during normal school hours is not permitted.

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces.

C. Coordinate meter pad size, location, and service requirements with UGI Gas Company. Provide concrete pad for meter.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   a. Material Group: 1.1.
   b. End Connections: Threaded or butt welding to match pipe.
   c. Lapped Face: Not permitted underground.
   d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
   e. Bolts and Nuts: ASME B18.2.1, galvanized
   f. steel aboveground and stainless steel underground.
5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
   a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
6. Mechanical Couplings:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Dresser Piping Specialties; Division of Dresser, Inc.
      2) Smith-Blair, Inc.
   b. Steel flanges and tube with epoxy finish.
   c. Buna-nitrile seals.
   d. Stainless-steel bolts, washers, and nuts.
   e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
   f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig (3.45 kPa).
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches (1830 mm).

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shut-off when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (862 kPa).

D. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (862 kPa).

E. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig (5170 kPa).

F. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

A. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

B. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F (540 deg C) complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig (862 kPa).
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.
6. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.
7. All valves shall be rated for gas service.

C. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig (862 kPa).
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with stainless steel Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. BrassCraft Manufacturing Company; a Masco company.
   b. Conbraco Industries, Inc.; Apollo Div.
   c. Lyall, R. W. & Company, Inc.
   d. McDonald, A. Y. Mfg. Co.
   e. Perfection Corporation; a subsidiary of American Meter Company.
   f. Maxitrol.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Stainless steel
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig (4140 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Lee Brass Company.
   b. McDonald, A. Y. Mfg. Co.

2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.

5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig (862 kPa).
7. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. McDonald, A. Y. Mfg. Co.
   b. Mueller Co.; Gas Products Div.
   c. Xomox Corporation; a Crane company.

2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig (862 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Valve Boxes:

1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches (125 mm) in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.5 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 (DN 50) and smaller; flanged for regulators NPS 2-1/2 (DN 65) and larger.
5. Vent Limiters are prohibited.

B. Service Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Fisher Control Valves and Regulators; Division of Emerson Process Management.
   b. Invensys.
   c. Equimeter.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.

8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Provide stainless-steel screen in opening if not provided in Vent Temination.
12. Maximum Inlet Pressure: 100 psig (690 kPa).

C. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Fisher Control Valves and Regulators; Division of Emerson Process Management.
   b. Invensys.
   c. Maxitrol Company.
   d. Equimeter.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Stainless-steel screen in opening if not provided in vent termination.
12. Maximum Inlet Pressure: 2 psig (13.8 kPa).

D. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eclipse.
   b. Eaton Corporation; Controls Div.
   c. Harper Wyman Co.
   d. Maxitrol Company.
   e. SCP, Inc.
   f. Fischer.

2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator vent limiting device, instead of vent connection. Pipe all vents to the exterior.
9. Maximum Inlet Pressure: 2 psig (13.8 kPa).

2.6 DIELECTRIC FITTINGS

A. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
   d. Wilkins; Zurn Plumbing Products Group.

2. Minimum Operating-Pressure Rating: 150 psig (1034 kPa).
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

B. Dielectric-Flange Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Advance Products & Systems, Inc.
   b. Calpico Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.

2. Minimum Operating-Pressure Rating: 150 psig (1034 kPa).
3. Companion-flange assembly for field assembly.
4. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
5. Insulating materials suitable for natural gas.
6. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

C. Dielectric unions and couplings are not permitted.

2.7 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 and the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 and the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54, the International Fuel Gas Code and utility provider for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches (900 mm**)** below finished grade. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

1. If natural-gas piping is installed less than 36 inches (900 mm) below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

3.4 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap and relief vent pipe and fittings shall be galvanized.

O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches (38 mm) of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
   a. Exception: Tubing passing through partitions or walls does not require striker barriers.
5. Prohibited Locations:
   a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
   b. Do not install natural-gas piping in solid walls or partitions.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

T. Do not use natural-gas piping as grounding electrode.

U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

V. Install pressure gauge upstream and downstream from each line regulator. Pressure gauges are specified in Division 22 Section "Meters and Gauges for HVAC Piping."

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22

X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22

Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22

Z. Provide a manual gas shut-off valve(s) for gas piping serving individual appliances and kitchen equipment.

AA. Provide a gas pressure regulator to reduce pressure to gas piping serving individual appliances and kitchen equipment.

BB. Coordinate all gas piping requirements, type of outlets, locations, and quantities of outlets with the kitchen/food service Contractor.

CC. Appliances include but not limited to makeup air unit, boilers, water heaters, emergency generator and all cooking equipment.

DD. Install all valving and piping to the emergency generator in accordance with the authorities having jurisdiction, IPC, NFPA and the manufacturer's recommendations. Locate shut-off valves to building downstream of runout to generator. Provide a ten (10) foot section, two (2) pipe sizes larger than runout piping at generator connection or increased pipe size as indicated on the drawings. Provide lockable gas shut off valve at generator.

EE. Pipe all vents from regulators to the outdoors and terminate with mushroom cap with stainless steel screen.

3.5 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing. Pipe vents to the outdoors.

D. Install anode for metallic valves in underground PE piping.

E. Provide lockable ball valves at generator and at connection to pipe main.

3.6 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).
2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
4. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).
5. NPS 4 (DN 100) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 5/8 inch (15.8 mm).

3.8 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1800 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.9 LABELING AND IDENTIFYING

A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.10 PAINTING

A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.
    a. Prime Coat: Alkyd anticorrosive metal primer.
    b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    c. Topcoat: Exterior alkyd enamel (semigloss).
    d. Color: Yellow.

C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
    a. Prime Coat: Quick-drying alkyd metal primer.
    b. Intermediate Coat: Interior latex matching topcoat.
    c. Topcoat: Interior latex (flat).
    d. Color: Yellow.
2. Alkyd System: MPI INT 5.1E.
    a. Prime Coat: Quick-drying alkyd metal primer.
    b. Intermediate Coat: Interior alkyd matching topcoat.
    c. Topcoat: Interior alkyd (flat).
    d. Color: Yellow.

D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.12 OUTDOOR PIPING SCHEDULE

A. Aboveground natural-gas piping shall be one of the following:

1. Schedule 40 Steel pipe with malleable-iron fittings and threaded joints.
2. Schedule 40 Steel pipe with wrought-steel fittings and welded joints.

B. Containment Conduit for piping under hard surfaces: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

C. Containment Conduit Vent Piping for piping under hard surfaces: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

D. Underground natural gas piping shall be one of the following:
1. PE Pipe and fittings labeled as Natural Gas, joined by heat fusion with tracer wire terminated in an accessible location.
2. Steel pipe with wrought steel fittings and welded joints. Coat (polyethylene) pipe and fittings with protective coating for steel piping.

3.13 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG (3.45 kPa)

A. Aboveground, branch piping NPS 1 (DN 25) and smaller shall be the following:
   1. Schedule 40 Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:

   1. Schedule 40 Steel pipe with malleable-iron fittings and threaded joints.
   2. Schedule 40 Steel pipe with wrought-steel fittings and welded joints.

C. Underground, below building, piping shall be one of the following:
   1. Steel pipe with wrought-steel fittings and welded joints.

D. Containment Conduit for piping under hard surfaces: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

E. Containment Conduit Vent Piping for piping under hard surfaces: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG (3.45 kPa) AND LESS THAN 5 PSIG (34.5 kPa)

A. Aboveground, branch piping NPS 1 (DN 25) and smaller shall be the following:
   1. Schedule 40 Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:

   1. Schedule 40 Steel pipe with malleable-iron fittings and threaded joints.
   2. Schedule 40 Steel pipe with steel welding fittings and welded joints.

C. Underground, below building, piping shall be the following:
   1. Schedule 40 Steel pipe with wrought-steel fittings and welded joints.

D. Containment Conduit for piping under hard surfaces: Steel pipe with wrought-steel fittings and welded joints. Coat underground pipe and fittings with protective coating for steel piping.

E. Containment Conduit Vent Piping for piping under hard surfaces: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.15 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 (DN 50) and smaller at service meter shall be one of the following:

   1. One-piece, bronze ball valve with stainless steel trim.
   2. Two-piece, full-port, bronze ball valves with stainless steel trim.
   3. Bronze plug valve.

B. Valves for pipe sizes NPS 2-1/2 (DN 65) and larger at service meter shall be one of the following:

   1. Two-piece, full -port, bronze ball valves with stainless steel trim.
   2. Bronze plug valve.
   3. Cast-iron, nonlubricated plug valve.

C. Distribution piping valves for pipe sizes NPS 2 (DN 50) and smaller shall be one of the following:
   1. Two-piece, full-port, bronze ball valves with bronze trim.

2. Bronze plug valve.

D. Distribution piping valves for pipe sizes NPS 2-1/2 (DN 65) and larger shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, nonlubricated plug valve.

E. Valves in branch piping for single appliance shall be one of the following:
1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.

END OF SECTION

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Concrete bases.
11. Supports and anchorages.

B. Provide all labor, materials, equipment, and services necessary for and incidental to the complete installation and operation of all mechanical work.

C. Unless otherwise specified, all submissions shall be made to, and acceptances and approvals made by the Architect and the Engineer.

D. Contract Drawings are generally diagrammatic and all offsets, fittings, transitions and accessories are not necessarily shown. Furnish and install all such items as may be required to fit the work to the conditions encountered. Arrange piping, ductwork, equipment, and other work generally as shown on the contract drawings, providing proper clearance and access. Where departures are proposed because of field conditions or other causes, prepare and submit detailed shop drawings for approval in accordance with "Submittals" specified below. The right is reserved to make reasonable changes in location of equipment, piping, and ductwork, up to the time of rough-in or fabrication.

E. Conform to the requirements of all rules, regulations and codes of local, state and federal authorities having jurisdiction.

F. Be responsible for all construction means, methods, techniques, procedures, and phasing sequences used in the work. Furnish all tools, equipment and materials necessary to properly perform the work in first class, substantial, and workmanlike manner, in accordance with the full intent and meaning of the contract documents.

G. Indicate as separate line items in the Schedule of Values the following:

1. Coordination Drawings.
2. O & M Manuals.
3. Record Drawings/As-Builts.
4. ATC Shop Drawings

H. Coordinate the work under Division 23 with work of all other construction trades.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified at no cost to the owner. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 23.

D. Refer to installation and coordination drawings for additional information.

1.8 PERMITS AND FEES:

A. Obtain all permits and pay taxes, fees and other costs in connection with the work. File necessary plans, prepare documents, give proper notices and obtain necessary approvals. Deliver inspection and approval certificates to Owner prior to final acceptance of the work.

B. Permits and fees shall comply with the General Requirements of the specifications.

1.9 EXAMINATION OF SITE:

A. Examine the site, determine all conditions and circumstances under which the work must be performed, and make all necessary allowances for same. No additional cost to the Owner will be permitted for Contractor's failure to do so.

1.10 CONTRACTOR QUALIFICATION:

A. Any Contractor or subcontractor performing work under Division 23 shall be fully qualified and acceptable to the Architect. Submit the following evidence if requested.

1. A list of not less than five comparable projects that the Contractor completed.
2. Letter of reference form not less than three registered professional engineers, general contractors or building owners.
3. Local and/or State License, where required.
4. Membership in trade or professional organizations where required.

B. A Contactor is any individual, partnership, or corporation, performing work by Contract or subcontract on this project.

C. Acceptance of a Contractor or Subcontractor will not relieve the Contractor or subcontractor of any contractual requirements or his responsibility to supervise and coordinate the work, of various trades.

1.11 MATERIALS AND EQUIPMENT:

A. Materials and equipment installed as a permanent part of the project shall be new, unless otherwise indicated or specified, and of the specified type and quality. This Contractor shall be responsible for connecting all utilities as shown on the Drawings to equipment identified as “Under Another Division”.

B. Where material or equipment is identified by proprietary name, model number and/or manufacturer, furnish named item, or its equal of manufacturer indicated in this specification. Alternate Manufacturers (other than first named or indicated as the basis of design) shall be equal or better in quality and performance and must be suitable for available space, required arrangement, and application. Submit all data necessary to determine suitability of alternate manufacturers for review.

C. The suitability of named item only has been verified. Where more than one Manufacturer is named, only the first named Manufacturer has been verified as suitable. Manufacturers and items other than first named shall be equal or better in quality and performance to that of specified items, and must be suitable for available space, required arrangement and application. The contractor is responsible for all cost associated with alternate manufacturers if different than the basis of design including power connection requirements, structural cost, etc. The contractor is responsible for the burden of proof that submitted alternate manufactures meet the specification and performance requirements of the basis of design product.

D. Substitution (manufacturer or items not listed) will not be permitted for specified items of material or equipment.

E. The Contractor shall only submit those manufacturers indicated in the specification or included by Addendum. Proposed manufacturers not specified will not be considered unless the specific item indicates "or as approved equal" or “but are not limited to”. Submit all data necessary to determine suitability of alternative manufacturers’ items for approval. Failure to do so will result in a “Revise and Resubmit” response.

F. Refer to the General Conditions of this specification for additional information, including substitution request. Substitutions are for materials or manufacturers not listed in this specification. For each substitution proposed by the Contractor, the Contractor clearly identifies all differences (i.e., paragraph-by-paragraph, performance differences, physical differences, etc.) from the specified item, changes in Contract cost, benefits to the Owner and a brief description why the substitution is being proposed.

G. Where only one manufacturer is listed, provide that manufacturer-sole source.

1.12 FIRE SAFE MATERIALS

A. Unless otherwise indicated, materials and equipment shall conform to UL, NFPA or ASTM Standards for fire safety with smoke and fire hazard rating not exceeding flame spread of 25 and smoke developed of 50.

1.13 REFERENCED STANDARDS, CODES AND SPECIFICATIONS:

A. Specifications, Codes and Standards listed below are included as part of this specification, latest edition.

AABC - Associated Air Balance Council
ABMA - American Boiler Manufacturers Association
ACCA - Air Conditioning Contractors of America
ACGIH - American Conference of Governmental Industrial Hygienist
AIHA - American Industrial Hygiene Association
ASA - Acoustical Society of America
ADC - Air Diffusion Council
AGA - American Gas Association
AMCA - Air Movement and Control Association
ANSI - American National Standards Institute

ARI	-	Air Conditioning and Refrigeration Institute
ASHRAE	-	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing and Materials
AWWA	-	American Water Works Association
CABO	-	Council of American Building Officials
CAGI	-	Compressed Air and Gas Institute
CS	-	Commercial Standard
CSA	-	Canadian Standards Association
CISPI	-	Cast Iron Soil Pipe Institute
IBC	-	International Building Code, Latest Edition.
IBR	-	Institute of Boiler and Radiator Manufacturers
IEEE	-	Institute of Electrical and Electronics Engineers
IMC	-	International Mechanical Code, Latest Edition
MSSP	-	Manufacturers Standards Society of the Valve and Fittings Industry
NEC	-	National Electrical Code
NEMA	-	National Electrical Manufacturers Association
NFPA	-	National Fire Protection Association
NSPC	-	National Standard Plumbing Code, Latest Edition
SMACNA	-	Sheet Metal and Air Conditioning Contractors National Association
TEMA	-	Tubular Exchanger Manufacturers Association
UL	-	Underwriters' Laboratories

B. All mechanical equipment and materials shall comply with the codes and standards listed in the latest ASHRAE Handbook

1.14 SUBMITTALS REVIEW AND ACCEPTANCE:

A. Equipment, materials, installation, workmanship and arrangement of work are subject to review and acceptance. No substitution will be permitted after acceptance of equipment or materials except where such substitution is considered by the Engineer to be in the best interest of the Owner.

B. Within 30 calendar days after award of contract, submit Material and Equipment List for approval. List all materials and equipment, indicating manufacturer, type, class, model, curves, and other general identifying information.

C. After acceptance of Material and Equipment List, submit complete descriptive data for all items. Data shall consist of specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, sound data, performance certifications, wiring diagrams, specific electrical/wiring requirements and connections including control and interlock wiring, installation instructions, and any other information necessary to indicate complete compliance with Contract Documents. Edit submittal data specifically for application to this project or submittal shall be rejected.

D. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and all electrical requirements for equipment submitted. Submit the Electrical Connection information specified in Division 26 for each piece of equipment requiring electrical connections. As a minimum, the Electrical Connection Information shall include horsepower or kVA, voltage and phase, power factor, capacitor, motor starter, disconnect and controls. Indicate which Division is providing the devices. Each piece of equipment and its associated components (fuses, relays, etc.) shall be clearly identified. Failure to include this schedule in the submittal will result in the submittal being returned to the Contractor for resubmission due to incompleteness of the submittal. If the Contractor submits equipment other than that used for the basis of design, and if the electrical connection requirements are different, the Contractor shall be responsible for any associated increase in cost (e.g., wiring, conduits, starters, disconnects, etc.). Similarly, if mechanical equipment size or weight are different, which affects the structural design (support, size, access), the mechanical contractor shall include all cost in their bid for structural redesign, signed and sealed drawings to be reviewed by the Structural Engineer of Record. Maintain and submit a summary of all electrical connection schedules of approved equipment. All mechanical equipment must be approved before electrical distribution equipment shall be approved for

fabrication (i.e., MC, switchboard, emergency generator, distribution panels, etc.) Contractor shall be responsible for correctness of all submittals.

E. Submittals will be reviewed for general compliance with design concept in accordance with contract documents, but dimensions, quantities, or other details will not be verified.

F. Identify submittals, indicating intended application, location and service of submitted items. Refer to specification sections or paragraphs where applicable. Clearly indicate exact type, model number, manufacturer, style, size and special features of proposed item. Submittals of a general nature will not be acceptable. For all items clearly list on the first page of the Submittal all differences between the specified product and the submitted product. Additionally, for items other than first-named or indicated as the Basis of Design, clearly list on the first page of the submittal all differences between the specified item and the proposed item. This includes a paragraph-by-paragraph comparison from the Specification, performance differences from that scheduled and/or indicated on the Drawings, including power connection requirements, sound, etc., and physical differences (size, weight, access for service and maintenance, etc.) based on published data (i.e., including Web sites.) The Contractor shall be responsible for all costs associated with utilizing materials and equipment other than first named (including costs for all other trades such as electrical connection requirements, structural design, etc.) including corrective action (or replacement with the specified item) while maintaining the specification requirements.

G. Submit actual operating conditions or characteristics for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable.

H. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted.

1.15 SHOP DRAWINGS:

A. Prepare and submit shop drawings within ten calendar days after award of contract for all specially fabricated items, modifications to standard items, specially designed systems where detailed design is not shown on the contract drawings, or where the proposed installation differs from that shown on contract drawings.

B. Submit data and shop drawings as listed below, in addition to provisions of paragraph 1 above. Identify all shop drawings by the name of the item and system and the applicable specification paragraph number.

Items and Systems Included But Not Limited To:

Access Doors.
Air-Cooled Chillers.
Air and dirt separations.
Air Distribution Systems.
Air Handling Units (all types).
Automatic Air Vents.
Automatic Temperature Control & Energy Management System & Equipment.
Backflow Preventer.
Baseboard Radiation.
Breeching and flues.
Cabinet Unit Heaters.
Capacitors.
Chemical Feed Systems.
Combination Fire/Smoke Dampers.
Dehumidification Units
Ductless Split A/C Unit.
Energy Recovery Ventilators
Expansion Tanks and Accessories.
Fans.
Fire Dampers.
Fire Stopping - Methods and Materials.
Flowmeters and Primary Elements. (Flow Fittings)

Glycol System.
Grilles, Registers, Diffusers, and Fire Dampers.
Gravity Roof Vents.
Hot Water Boilers.
Identification System.
Manual Air Vents.
Pipe Enclosures
Pipe Guides, Anchors, Hangers, and Supports.
Pipe Materials and Fittings.
Pipe Sleeves Including Sealants.
Pressure Relief Valve.
Pressure Reducing Valve.
Pressure Regulating Valve.
Pumps, Circulators, Suction Diffusers, Multi-Purpose Valves.
Roof Curb Assemblies.
Sleeves.
Smoke Dampers.
Split Systems
Strainers.
Thermal Insulation Materials.
Thermometers and Gauges.
Unit Heaters.
Valves - Globe, Angle, Check, Plug, Butterfly, Ball, Shut Off/Balancing.
Variable Speed Drives.
Vibration Isolation.
Water to Water Heat Pump

C. Contractor, additionally, shall submit for approval any other shop drawings as required by the Architect or Owner. No item listed above shall be delivered to the site, or installed, until approved. After the proposed materials have been approved, no substitution will be permitted except where approved by the Architect/Owner.

1.16 SUPERVISION AND COORDINATION

A. Provide complete supervision, direction, scheduling, and coordination of work under the Contract, including that of subcontractors.

B. Coordinate rough-in of work and installation of sleeves, anchors, and supports for piping, ductwork, and other work performed under Division 23.

C. Coordinate electrical work required under Division 23 with that under Division 26. Coordinate work under Division 23 with work under other Divisions.

D. Coordinate the work under Division 23 with the work of all other construction trades.

E. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

F. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

G. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 23.

1.17 CUTTING AND PATCHING

A. Accomplish all cutting and patching necessary for the installation of work under Division 23. Damage resulting from this work to other work already in place, shall be repaired at Contractor's expense. Where

cutting is required, perform work in neat and workmanlike manner. Restore disturbed work to match and blend with existing, using materials compatible with the original. Use mechanics skilled in the particular trades required.

B. Do not cut structural members without approval.

1.18 PENETRATION OF WATERPROOF CONSTRUCTION:

A. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls, and interior waterproof construction. Where such penetrations are necessary, furnish and install all necessary curbs, sleeves, flashings, fittings and caulking to make penetrations absolutely watertight.

B. Where vents or other pipes penetrate roofs, flash pipe with All American Metal, Inc., or approved equal, roof flashing assemblies, with 4-pound lead, 6-inch skirt and caulked counterflashing sleeve with cap.

C. Furnish and install roof drains, vent assemblies, and duct sleeves specifically designed for application to the particular roof construction, and install in accordance with the manufacturer's instructions, The National Roofing Contractors Association, SMACNA and as required by other divisions of this specification. The Contractor shall be responsible for sleeve sizes and locations.

D. Roof curbs for mechanical systems and equipment shall be provided by the Mechanical Contractor.

E. Pitch pockets are prohibited. Provide curb assemblies and pipe portals with watertight boots (pate type PCC or equal) as detailed on the drawings.

F. Coordinate all roof penetration, flashing and installation of roof mounted equipment with the Roofing Contractor.

1.19 VIBRATION ISOLATION

A. Furnish and install vibration isolators, flexible connections, supports, anchors, and/or foundations required to prevent transmission of vibration from equipment, piping, or ductwork to building structure. Penetrations of ductwork, piping, and conduits through walls and floor/ceiling/roof assemblies shall be oversized by ½”-1”. There shall be no contact between the penetrating element and the partition and the resultant gap shall be filled with closed cell foam backer rod and acoustical sealant for an air tight seal. See Section 230548, VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT.

1.20 ACCESSIBILITY

A. All equipment shall be installed in such a way that all components requiring access (such as panels, disconnect switches, circuit breakers, starters, and accessories) are so located and installed that they may be serviced, reset, replaced, recalibrated, etc., by service technicians in accordance with the Manufacturer’s recommendations. If any equipment or components are located in such a position that this Contractor cannot comply with the above, the Contractor shall notify the engineer in writing before equipment is installed.

B. All valves shall be readily accessible, tagged and be provided with a location label.

C. Maintain all recommended equipment clearances for service, maintenance, and equipment replacement. Demonstrate how all filters can be easily replaced, components (fans, coils, etc.) can be replaced and maintain all required clearances for equipment electrical panels and control panels.

1.21 CONCRETE AND MASONRY WORK:

A. Furnish and install concrete and masonry work for equipment foundations, housekeeping pads, supports, pads, and other items required under Division 23. Perform work in accordance with requirements of other applicable Divisions of these specifications. Coordinate size and location of all sleeves, concrete inserts, etc., with other Divisions, equipment connections, and approved casework Shop Drawings.

B. Concrete shall test not less than 5,000 psi compressive strength after 28 days.

C. Grout shall be non-shrink, high strength mortar, free of iron of chlorides and suitable for use in contact with all metals, without caps or other protective finishes. Apply in accordance with manufacturer's instructions and standard grouting practices.

1.22 DRIVE GUARDS

A. Provide safety guards on all exposed belt drives, motor couplings, and other rotating machinery. Provide fully enclosed guards where machinery is exposed from more than one direction.

B. Fabricate guards of heavy gauge steel, rigidly brace, removable, and finish to match equipment served. Provide openings for tachometers. Guards shall meet O.S.H.A. and Authorities Having Jurisdiction requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, galvanized steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.
2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Available Manufacturers:

a. Eslon Thermoplastics.

B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

1. Manufacturers:

a. Thompson Plastics, Inc.

C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

1. Manufacturers:

a. NIBCO INC.
b. NIBCO, Inc.; Chemtrol Div.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.

d. Watts Industries, Inc.; Water Products Div.

D. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.

E. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

1. Manufacturers:

a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.
e. Garlock Linkseal.

2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Reinforced Nylon Polymer. Include two for each sealing element.
4. Connecting Bolts and Nuts: Type 316 Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, galvanized, plain ends.

B. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

C. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

C. One-Piece, Floor-Plate Type: Cast-iron floor plate.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.

M. Sleeves are required for core-drilled holes.

N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are two pipe sizes larger than pipe or pipe insulation.

a. Galvanized Steel Pipe Sleeves: For pipes penetrating floors, walls and roofs except where noted through membrane waterproofing.
b. Galvanized steel sheet sleeves: For pipes penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing. Seal space outside of sleeve fittings with grout.
d. Provide galvanized steel sheet sleeves for interior stud partitions.
e. Provide galvanized steel wall sleeves with sleeve seal system for walls below grade and concrete slabs on grade. Select sleeve size to allow one-inch annular clear space between piping and sleeve for installing sleeve seal system. Select type, size and number of sealing elements required for piping material and size for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve system components and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a water-tight seal.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size two pipe sizes larger than pipe and sleeve for installing mechanical sleeve seals.

Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

S. Verify final equipment locations for roughing-in.

T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.
5. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric nipples and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Painting of mechanical systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting," unless otherwise indicated.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

C. Provide protective finishes on all materials and equipment. Use coated or corrosion-resistant materials, hardware and fittings throughout the work. For interior components, paint bare, untreated ferrous surfaces with rust-inhibiting paint. All exterior components including supports, hangers, vibration isolators, etc., shall be galvanized or stainless steel. All exterior fastening components such as rods, nuts, bolts, washers, etc., shall be stainless steel.

D. Clean surfaces prior to application of insulation, adhesives, coatings, paint, or other finishes.

E. Provide factory-applied finishes where specified. Unless otherwise indicated factory-applied paints shall be baked enamel with proper pretreatment.

F. Protect all finishes and restore any finishes damaged as a result of work under Division 23 to their original condition.

G. The preceding requirements apply to all work, whether exposed or concealed.

H. Remove all construction marking and writing from exposed equipment, piping and building surfaces. Do not paint manufacturer's labels or tags.

I. All exposed ductwork, piping, equipment, etc. in an occupied space shall be painted. All finishes shall have a paint grip finish, including galvanized ductwork which shall be Gavanneal type. Colors shall be selected by the Architect and conform to ANSI Standards.

J. Submit color of factory-finished equipment for approval prior to ordering. Color of finishes shall be as selected by Architect. All exposed cabinets for equipment (e.g., fin tube radiation, fan coil units, cabinet unit heaters, terminal heating devices, etc.) in finished areas shall be provided with custom colors as selected by the Architect.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 5000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section “Miscellaneous Cast-in-Place Concrete."
8. Housekeeping pads for air handling units and central plant generation equipment (boilers, heat exchangers, chillers, etc.) shall be a minimum of 6-inches thick. All other equipment pads shall be a minimum of 4-inches thick.
9. Provide wire-mesh or re-bar reinforcement; chamfer exposed edges and corners; and finish exposed surfaces smooth.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.9 SUPPORTS, HANGERS, AND FOUNDATIONS

A. Provide supports, hangers, braces, attachments and foundations required for the work. Support and set the work in a thoroughly substantial and workmanlike manner without placing strains on materials, equipment, or building structure, submit shop drawings for approval. Coordinate all work with the requirements of the structural division.

B. Supports hangers, braces, and attachments shall be standard manufactured items or fabricated structural steel shapes. All interior hangers shall be galvanized or steel with rust inhibiting paint. For uninsulated copper piping/tubing provide copper hanger with wool or felt insert to prevent contact of dissimilar metals. All exterior hangers shall be constructed of galvanized steel or stainless steel utilizing stainless steel rods, nuts, washers, bolts, etc.

C. No support or hanger shall attach to the metal roof deck.

D. Hangers shall attach at the panel point of the top chord of joist.

E. The building is primarily wood construction.

3.10 PROVISIONS FOR ACCESS:

A. The Contractor shall provide access panels and doors for all concealed equipment, valves, strainers, manual, gravity and automatic dampers, filters, controls, control devices, cleanouts, fire dampers, smoke dampers, combination fire and smoke dampers, damper operators, traps, and other devices requiring maintenance, service, adjustment, balancing or manual operation.

B. Where access doors are necessary, furnish and install manufactured steel door assemblies consisting of hinged door, cylinder with key locks (keyed alike), and frame designed for the particular wall or ceiling construction. Style M access door shall have stainless steel finish. All others shall have paintable finish. Properly locate each door. Review all locations with the Engineer and Architect in the field before installation. Door size shall be a minimum of 24" x 24". Provide UL approved and "B" labeled 12-Hour Access doors where installed in fire-rated walls or ceilings. Doors shall be Milcor Metal Access Doors as manufactured by Inland-Ryerson, Air Balance, Inc., Cesco, Karp Associates, Kees, or approved equal.

1.	Acoustical:	Style AT
2.	Hard Finish Plaster:	Style K
3.	Dry Wall:	Style DW
4.	Masonry	Style M

C. Where access is by means of lift-out ceiling tiles or panels, mark each ceiling grid using small color-coded or numbered tabs. Provide a chart or index for identification. Equipment, valves, dampers, and items requiring access for service and maintenance shall be provided with color coded identification labels. Charts shall be similar to valve charts specified hereinafter. Screw markers on ceiling grid.

D. Access panels, doors, etc., described herein shall be furnished under the section of specifications providing the particular service to be turned over to the pertinent trade for installation. Coordinate installation with installing Contractor.

E. Per the school districts standard provide white micarta nameplates with black lettering, the width of the ceiling grid, fastened by adhesive indicating the Air Handling unit, terminal control unit located above the ceiling (e.g.,AHU-X).

F. Label all access doors for Fire Dampers, Smoke Dampers and or Combination Dampers in Accordance with NFPA requirements.

3.11 PROTECTION OF WORK:

A. Protect work, material and equipment from weather and construction operations before and after installation. Properly store and handle all materials and equipment.

B. Cover temporary openings in piping, ductwork, and equipment to prevent the entrance of water, dirt, debris, or other foreign matter.

C. Cover or otherwise protect all finishes.

D. Replace damaged materials, devices, finishes and equipment.

3.12 OPERATION OF EQUIPMENT:

A. Clean all systems and equipment prior to initial operation for testing, balancing, or other purposes. Lubricate, adjust, and test all equipment in accordance with manufacturer's instructions. Do not operate equipment unless all proper safety devices or controls are operational. Provide all maintenance and service for equipment that is authorized for operation during construction.

B. Provide the services of the manufacturer's factory-trained servicemen or technicians to start up the equipment.

C. Do not use mechanical systems for temporary services during construction unless authorized in writing by the Owner or Architect. Where such authorization is granted, temporary use of equipment shall in no way limit or otherwise affect warranties or guaranty period of the work.

D. Upon completion of work, clean and restore all equipment to new conditions; replace expendable items such as filters.

E. If the mechanical systems are used at any time without written authorization from the Owner, other than for initial factory start-up and/or testing, balancing, and commissioning, all equipment and duct systems shall be thoroughly cleaned by this Contractor (i.e., coils, fans, variable speed drives, heat wheels, terminal units, split systems, supply, return and exhaust ducts, etc.) to restore the system and equipment to like-new condition. The Contractor is still responsible for all external cleaning to restore systems and equipment to like-new conditions. At no time will the HVAC be allowed to run when sanding, grinding, finishing, etc., type activities create dust.

F. Provide MERV 11 filters for return air grilles and outside air intake for anytime units are temporarily energized.

3.13 IDENTIFICATIONS, FLOW DIAGRAMS, ELECTRICAL DIAGRAMS AND OPERATING INSTRUCTIONS:

A. Contractor shall submit for approval schematic piping diagrams of each piping system installed in the building. Diagrams shall indicate valve location, service, type (i.e., butterfly, globe, ball, etc.) make, model number and the identification number of each valve in the particular system. Following approval by all authorities, the diagrams shall be framed, mounted under glass and hung in each Mechanical Room. Contractor shall deliver the electronic file from which the diagrams were reproduced to the Owner.

B. All valves shall be plainly tagged. Where valves are located above ceilings, mark the ceiling grid using a small color-coded or numbered tab. Screw marker to grid.

C. All items of equipment, including motor starters, ATC panels, terminal control units, etc., shall be furnished with white letters and numbers on black plastic identification plates or aluminum letters and numbers on black engraved aluminum identification plates. Lettering shall be a minimum of 1/4" high. Identification plates shall be securely affixed to each piece of equipment, starters, panels, etc. by screws. Pressure sensitive tape backing is prohibited. Utilize the school district coding system to match the school districts preventative maintenance system requirements.

D. Provide three (3) copies of operating and maintenance instructions for all principal items of equipment furnished. This material shall be bound as a volume of the "Record and Information Booklet" as hereinafter specified. Project shall not be considered “Substantially Completed” until provided.

E. All lines (piping and ductwork) installed under this contract shall be stenciled with "direction of flow" arrows and with stenciled letters naming each pipe and ductwork and service. Refer to Division 23 sections on piping. At the Contractors option, snap/strap around pre-coiled vinyl markers are acceptable.

F. Provide at least 40 hours of straight time instruction to the operating personnel. This instruction period shall consist of not less than five (5) 8-hour days. Time of instruction shall be designated by the Owner. As a minimum, three (3) additional eight (8) hour instruction times shall occur during 1) the first cooling season, 2) the first heating season, and 3) the first intermediate cooling/heating season. Additional instruction time for the Automatic Temperature Control (ATC) and Energy Management System (EMS) is specified in Section 230900 Automatic Temperature Controls. Provide two (2) external hard drives of recorded copies of all instructional periods/demonstrations including Automatic Temperature Control and Energy Management System.

3.14 WALL AND FLOOR PENETRATIONS

A. Provide sleeves for pipes and ducts passing through roofs, floors, ceiling, walls, partitions, air handling unit casings, structural members, and other building parts. Sleeves shall extend 2" above finished floor.

B. Provide escutcheons for sleeved pipes in finished areas.

C. Piping sleeves:
1. Galvanized steel pipe, standard weight where pipes are exposed and, roofs and concrete and masonry walls. On exterior walls provide anchor flange welded to perimeter.
2. Twenty-two (22) gauge galvanized steel elsewhere.
3. Hydrostatic sleeves with anchor flange for all below-grade exterior wall or floor penetrations and all PVC pipe penetrations.

D. Ductwork sleeves: 20 gauge galvanized steel at masonry walls, rated walls, at wall penetrations exposed to view, floors and roof.

E. Penetrations shall be sealed and caulked airtight for sound and air transfer control. Voids where ducts and pipes penetrate floors or other fire-rated assemblies shall be appropriately additionally fire-sealed the full depth with an approved fire sealant (3M or Dow Corning Fire Sealant Foam and Caulk). For piping, provide floor plate.

F. Where piping extends through exterior walls, provide link-seal water-proof sleeves or equivalent.

G. Provide 2" minimum double wall insulated blank off panels, painted black, sealed and fire/smoke stopped at floor penetrations to existing floor grilles in accordance with the AHS requirements.

3.15 RECORD DRAWINGS

A. Upon completion of the mechanical installations, the Contractor shall deliver to the Architect one complete set of prints of the mechanical contract drawings which shall be legibly marked in red pencil to show all changes and departures of the installation as compared with the original design. They shall be suitable for use in preparation of Record Drawings. Additionally, provide one (1) electronic format (color PDF/scanned image) of all record drawings on a USB drive.

3.16 GUARANTEE:

A. Contractor's attention is directed to guarantee obligations contained in the GENERAL CONDITIONS.

B. The above shall not in any way void or abrogate equipment manufacturer's guarantee or warranty. Certificates of guarantee shall be included in the operations and maintenance manuals. The project shall not be considered "substantially completed" until certifications are included in the Record and Information Booklets.

C. Contractor shall provide two (2) year full factory warranty on parts and labor for all equipment from the time of final acceptance of the mechanical systems by the Owner. Warranty shall include 24-hour service. Contractor shall provide five (5) year parts and labor warranty for all refrigeration systems (i.e., chillers, split systems/condensing units), including loss of refrigerant. Additional special extended warranties are included in equipment and material specification sections. The contractor shall be responsible for the specified warranty requirements and/or the difference between the manufactures warranty and the specified warranty. This service shall be rendered upon request when notified of any equipment malfunctions.

D. The guarantee shall not start until substantial completion has been accepted by the Owner.

E. Provide all equipment and system software updates for ten (10) years after substantial completion.

3.17 LUBRICATION:

A. All bearings, motors, and all equipment requiring lubrication shall be provided with accessible fittings for same. Before turning over the equipment to the Owner, the Contractor shall fully lubricate each item of equipment, shall provide one year's supply of lubricant for each, and shall provide Owner with complete written lubricating instructions, together with diagram locating the points requiring lubrication. Include this information in the Record and Information Booklet. Project shall not be considered “Substantially Completed” until instructions are included in the Record and Information Booklet.

B. In general, all motors and equipment shall be provided with grease-lubricated roller or ball bearings with Alemite or equal accessible or extended grease fittings and drain plugs.

C. Provide remote grease fittings with copper lube lines for air handling units and for bearings/motors where grease fittings are situated in locations inconvenient/inaccessible for lubrication.

D. Provide pressure relief fittings at all grease lubrication locations designed to automatically vent within the range of 1/4 to 1 psi, automatically reset below this range, or another pressure relief range if the preceding differs from the manufacturer’s recommended pressure range.

3.18 RECORD AND INFORMATION BOOKLET:

A. The Contractor shall have prepared three (3) copies of the Record and Information Booklet and deliver these approved copies of the booklet to the Owner a minimum of three (3) weeks before Demonstrations. The booklet shall be as specified herein. The booklet must be approved and will not be accepted as final until so stamped. The project shall not be considered “Substantially Completed” until approved.

B. The booklet shall be bound in a three-ring loose-leaf binder similar to "National" No. 3881 with the following title lettered on the front: "Record and Information Booklet (insert name of the project)". No sheets larger than 8-1/2" x 11" shall be used, except sheets that may be neatly folded to 8-1/2" x 11" and used as a pull-out.

C. Provide the following data in the booklet:

1. Catalog data on each piece of mechanical equipment furnished.
2. Maintenance operation and lubrication instructions on each piece of equipment furnished.
3. Complete catalog data on each piece of heating and air conditioning equipment furnished including approved shop drawing.
4. Manufacturers’ and Contractors' guarantees.
5. Chart form indicating time and type of routine maintenance of chillers, boilers, air handling units, heat recovery devices, condensing units, energy recovery devices, ATC System, pumps, fans, chemical treatment, unit heaters, etc. The chart shall also indicate tag number, model number of equipment, location and service. For replacement items such as filters and belts, indicate type, size and quantity of the replaceable items.
6. Provide sales and service representatives’ names and phone numbers of all equipment and subcontractors.
7. Catalog data of all equipment, valves, etc., which shall include wiring diagrams, parts list and assembly drawing.
8. Provide valve chart including valve tag number, valve type, valve model number, valve manufacturer, style, service and location, etc. as specified hereinafter.
9. Copy of the approved balancing report.
10. Provide operating curves indicating design and balanced conditions for fans and pumps.
11. ATC systems, including as-built ATC drawings of systems, sequences of operation including internal devices and wiring within panels.
12. Provide an electronic data base of all equipment, including model number, location tag/identification label.
13. Provide copies of all flushing reports.
14. Provide copies of all start-up reports.
15. Provide external hard drives of all demonstration and instructional periods.
16. Provide external hard drives of all Coordination Drawings.

D. In addition to three (3) hard copies of the data described in Paragraph C, provide three (3) electronic copies in PDF format on external hard drives of the entire O&M Manual.

3.19 TESTS, GENERAL:

A. The entire heating and cooling system shall be tested hydrostatically for a duration of 4 hours before insulation covering is applied and proved tight under the following gauge pressures:

1.	Make-up Water and Coil Drain Piping	100 psi
2.	Chilled and Heating Water Piping	100 psi

B. All testing shall be witnessed by the Owner or Engineer and Local Code Official. The Contractor shall provide a minimum of 48-hour notice before testing. The Contractor shall coordinate with and get approval from the Owner.

3.20 LINTELS:

A. Under this Section, provide lintels not provided elsewhere which are required for openings for the installation of mechanical and plumbing work. Lintels shall meet the requirements of the Architectural and Structural Sections and The Architectural Drawings and Specifications.

3.21 EQUIPMENT BY OTHERS:

A. This Contractor shall make all system connections required to equipment furnished and installed under other divisions. Connections shall be complete in all respects to render this equipment functional to its fullest intent.

B. It shall be the responsibility of the supplier of this equipment to furnish complete instructions for connections. Failure to do so will relieve this Contractor of any responsibility for improper equipment operation.

C. Typical equipment refers to, but is not limited to kiln hoods, kitchen equipment, etc.

3.22 FASTENERS:

A. All fasteners located in public space (toilet rooms, corridors) shall be provided with tamper-proof type fasteners.

3.23 WIRING DIAGRAMS

A. Obtain and submit wiring diagrams for all equipment provided under this Contract.

B. Wiring diagrams shall be provided with Shop Drawings, but not limited to, the following:

1. All equipment.
2. ATC System.

C. The Contractor shall submit any additional wiring diagrams as requested by the Engineer.

D. Provide wiring diagrams for all major mechanical equipment to the Electrical Contractor and the ATC Subcontractor for coordination.

3.24 INSTALLATION AND COORDINATION DRAWINGS

A. Prepare, submit, and use composite installation and coordination drawings to assure proper coordination and installation of work. Drawings shall include, but not be limited, to the following: Complete Ductwork, Plumbing, Sprinkler and HVAC Piping Drawings showing coordination with approved equipment, approved casework drawings, lights, conduits 2" and larger, electrical equipment and structural. The Mechanical Contractor is responsible for coordinating with all trades to insure systems will fit in the available space. If conflicts exist after fabrication and/or installation of systems prior to preparing a coordinated drawing of the area, the Contractor shall remove, re-fabricate, and re-install all such work at their own cost, except for the difference in cost, if any, from the originally designed system to the revised design. If no design changes were made, and clarifications were required, it shall be at no expense to the Owner.

B. Draw plans to a scale not less than 3/8-inch equals one foot. Include plans, sections, and elevations of proposed work, showing all equipment, piping and ductwork in areas involved. Fully dimension all work including hoods, casework and associated utilities, valve boxes, lighting fixtures, conduits, pullboxes, panelboards, and other electrical work, telecommunications equipment, walls, doors, ceilings, columns, beams, joists and other architectural and structural work.'

C. Identify all equipment and devices on wiring diagrams and schematics. Where field connections are shown to factory-wired terminals, include manufacturer's literature showing internal wiring.

D. All coordination drawings shall be prepared in AutoCAD or Revit format and submitted in color. Different colors shall be used to determine different building components. In addition to the composite coordination drawings, simultaneously submit individual sheet-metal, piping, and sprinkler coordination drawings.

E. Prepare separate coordinated reflected ceiling plans in 1/8", 1/4", or 3/8" scale showing grid systems, lighting fixtures, communication system components, TV brackets, sprinkler heads, air devices, and all other ceiling-mounted items.

F. The Mechanical Contractor shall schedule bi-weekly Coordination Drawing Reviews with the Owner, Mechanical Engineer, and all associated subcontractors, including but not limited to the following:

1. Mechanical Contractor
2. Finishes Contractor
3. Sheet Metal Contractor
4. Sprinkler Contractor
5. Electrical Contractor
6. Plumbing Contractor
7. Owner/Architect/Engineer
8. Note: A Foreman or Project Manager responsible for Decision-Making of each company shall attend all Coordination Meetings.

G. The purpose of these meetings is to coordinate proposed installations of systems and equipment, including clearances, routing, penetrations, as well as to review potential conflicts. The Mechanical Contractor shall base preliminary equipment sizes and connections on proposed products and the final coordination drawing for review shall reflect approved/reviewed products. Coordination Meetings shall be held at the Contractor's Field Office.

3.25 BOILER AND PRESSURE VESSELS

A. All boilers and pressure vessels shall be ASME-rated and shall comply with the State of Maryland requirements.

B. Provide all control devices and materials, and install in with ASME CSD-1 Controls and Safety Devices for Automatically Fired Boilers.

3.26 FACTORY START-UP

A. Provide factory authorized start-up service for all mechanical equipment (e.g., variable speed drives, air handling units, boilers, chillers, fans, blower/fan coil units, etc.). Coordinate all start-ups with the Commissioning Agent.

B. Provide one copy of all start-up reports to the Owner and include a copy in the Record and Information Booklet.

C. Pre-Installation /Start-Up Conference:

1. The Equipment Unit Manufacturer (each) shall include in their Bid a Pre-Installation Conference, including Factory Representative(s) to review installation, EMS Integration, Sequence to Operation, and Start-Up. Coordinate all controls with the Controls Contractor prior to energizing any unit, including final commissioning of each unit with the ATC/EMS Contractor and Test & Balance Contractor. All controls and start-ups shall be by the factory (i.e., not factory-authorized start-up company).
2. The Mechanical Contractor shall include in their Bid an on-site pre-installation conference for the main mechanical equipment room to review layout and coordination of all equipment and subcontractors involved in working in the mechanical equipment room. As a minimum, the attendees need to include the following:
   a. Mechanical Contractor
   b. Electrical Contractor
   c. Building ATC Contractor
   d. Sheet Metal Contractor
   e. Owner
   f. Mechanical Engineer
   g. Commissioning Agent.
3. The Contractor(s) shall mark on the floors, walls, and/or ceilings, the locations of major equipment and/or penetration of systems.
4. Prior to the start of construction, the Mechanical Engineer, Owner and Architect shall review design goals, design intent, project summary, and past construction issues which should be avoided. The Mechanical Contractor shall coordinate, document, and issue minutes of the meeting. As a minimum, and in addition to the Mechanical Engineer, Owner and Architect, the attendees shall include:
   a. Mechanical Contractor
   b. Project Superintendent
   c. Commissioning Agent
   d. Electrical Contractor
   e. Building ATC Contractor
   f. Plumbing Contractor
   g. Major Equipment Manufacturers' Representative(s)
   h. Sprinkler Contractor

D. The Contractor shall be required to start up all systems in an orderly, organized, and coordinated manner to ensure that all systems are functioning as designed. The Mechanical Contractor shall provide a detailed start-up, testing and demonstration plan for all systems in a coordinated manner that is documented in writing at least forty-five (45) days prior to start-up. Start-up, testing, and demonstration plans shall include detailed point-by-point check list that clearly shows that systems are in face functioning as designed. As a modification to the standard AIA definition of substantial completion, the Mechanical Systems are not substantially complete until all systems are started, tested, balanced, and O&M Manuals are received by the Owner. Above listed items must be completed in time to allow for system demonstrations to the school district's Personnel with all O&M Manuals in hand at the time of demonstration. Contractors will be required to provide system demonstrations and training for the school district's Personnel for each system. At minimum, the Contractors shall provide eight (8) hours of demonstration and eight (8) hours of systems operation training for each system prior to the school district acceptance of any given system.

3.27 MECHANICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment including, but not limited to, the following:

1. Coordinate mechanical systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed, noted, or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished space.
10. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of equipment components in accordance with manufacturers' recommendations. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
11. Install access panels or doors where units are concealed behind finished surfaces.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
13. Keep all areas which are under construction under a negative pressure relative to adjacent interior spaces to create infiltration to the construction zone while preventing exfiltration of dust and odors to occupied or finished areas of the building.
14. Provide equipment in knockdown form and reassemble in the field where required for rigging and installation. The equipment manufacturer shall perform or oversee the work to maintain equipment warranty.

3.28 CLEANING OF SYSTEMS:

A. Thoroughly clean systems after satisfactory completion of pressure tests and before permanently connecting fixtures, equipment, traps, strainers, and other accessory items. Shut-off valves serving equipment where by-pass valves have been provided shall be closed to the equipment and by-pass valves shall be open during flushing. Blow out and flush piping until interiors are free of foreign matter. Restore valves to their normal operating positions after flushing has been completed. Flushing, chemicals, sterilization, etc., shall comply with EPA Regulations and authorities having jurisdiction.

B. Flush piping in recirculating water systems to remove cutting oil, excess pipe joint compound and other foreign materials. Do not use system pumps until after cleaning and flushing has been accomplished to the satisfaction of the Engineer. Employ chemical cleaners, including a non-foaming detergent, not harmful to system components. After cleaning operation, final flushing and refilling, the residual alkalinity shall not exceed 300 parts per million. Submit a certificate of completion to Engineer stating name of service company that was used. Project shall not be considered "substantially completed" until certificate is incorporated in the "Record and Information Booklet".

C. Leave strainers and dirt pockets in clean condition.

D. Clean fans, ductwork, enclosures, registers, grilles, and diffusers at completion of work.

E. Install filters of equal efficiency to those specified in permanent air systems operated for temporary heating or cooling for testing and balancing. At no time shall the permanent equipment be used during construction except as required for testing and balancing and/or commissioning of systems, which shall be approved by the Owner. Replace with clean filters as specified prior to acceptance and after cleaning of system.

F. Pay for labor and materials required to locate and remove obstructions from systems clogged with construction refuse after acceptance. Replace and repair work disturbed during removal of obstructions.

G. Leave systems clean, and in complete running order.

3.29 LOUVERS:

A. All louvers to be provided in exterior walls shall be furnished and installed under another division unless otherwise indicated on the drawings or in the specifications. All brick vents, wall caps and louvers not indicated on the architectural drawings shall be provided under this division. Louver shop drawings shall be submitted to the Engineer to verify sizes and free area requirements. The Contractor shall blank-off unused portions of louver with insulated double wall type blank-off panels.

3.30 FILTERS:

A. Provide one (1) set of clean filters for balancing. Two (2) complete set of additional filters shall be turned over to the Owner upon final acceptance of the building by the Owner. Provide correspondence documenting that additional filters have been turned over to the Owner.

B. All air handling unit pre-filters shall be 2” thick, 30% efficient (MERV 8), Camfil Farr 30/30, or as approved equal. All final filters shall be 12 thick, 85% efficient (MERV 13), Camfil Farr HP-P65 with Media Retainer Assembly, or as approved equal. Where final filters are indicated to be 4” thick, provide 85% efficient (MERV13) Camfil Farr Opti-Pac.

C. Provide MERV 11 filters for all intakes (return air grilles, outside air louvers, all AHU and terminal unit filters, etc.), if for any reason (start-up, testing and balancing, commissioning, etc.) the units are started prior to final building cleaning. Filters shall be 1”, 2” or 4” thick; Camfil Farr AP-11, or as approved equal.

D. Provide one (1) differential pressure gauge across each filter bank. Differential pressure gauge shall be diaphragm activated, dial type, +/-2% accuracy of full scale, static pressure tips, aluminum tubing, vent valves, etc. Differential pressure gauge shall be Series 2000 magnahelic with air filter kit as manufactured by Dwyer or equal.

3.31 BELT GUARDS/CAGES/BELTS

A. Provide safety guards on all exposed belt drives, motor couplings, and other rotating machinery (pump coupling, plenum fans, propeller fans, etc.) Provide fully enclosed guards where machinery is exposed form more than one direction.

B. Fabricate guards of heavy gauge steel, rigidly braced, removable, and finished to match equipment served. Provide openings for tachometers. Guards shall meet OSHA requirements.

C. Provide one (1) spare set of belts for each piece of equipment. Belts shall be labeled with unit number and location. Belts shall be mounted as directed by the Owner.

3.32 ACCESS FOR INSPECTION, CLEANING AND MAINTENANCE

A. Individual finned-tube coils or multiple finned-tube coils in series without adequate intervening access space(s) of at least 18 inches (457 mm) shall be selected to result in no more than 0.75 inches wc (187 Pa) combined pressure drop when dry coil face velocity is 500 fpm (2.54 m/s). Exception: When clear

and complete instructions for access and cleaning of both upstream and downstream coil surfaces are provided.

B. Equipment Clearance: Ventilation equipment shall be installed with sufficient working space for inspection and routine maintenance (e.g., filter replacement and fan belt adjustment and replacement).

C. Ventilation Equipment Access: Access doors, panels, or other means shall be provided and sized to allow convenient and unobstructed access sufficient to inspect, maintain, and calibrate all ventilation system components for which routine inspection, maintenance, or calibration is necessary. Ventilation system components comprise, for example, air-handling units, fan-coil units, water-source heat pumps, other terminal units, controllers, and sensors.

D. Air Distribution System: Access doors, panels, or other means shall be provided in ventilation equipment, duct-work, and plenums, located and sized to allow convenient and unobstructed access for inspection, cleaning, and routine maintenance of the following:
   1. Outdoor air intake areaways or plenums
   2. Mixed air plenums
   3. Upstream surface of each heating, cooling, and heat-recovery coil or coil assembly having a total of four rows or less
   4. Both upstream and downstream surface of each heating, cooling, and heat-recovery coil having a total of more than four rows and air washers, evaporative coolers, heat wheels, and other heat exchangers
   5. Air cleaners
   6. Drain pans and drain seals
   7. Fans

E. Equipment shall be located such that it can be easily replaced without affecting other equipment or structure.

3.33 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.34 TRAINING AND CERTIFICATION

A. Provide factory training for four (4) of the Owner's representatives in a factory training lab working with simulators for the following equipment. Training can occur at the local Sales Representative training center.

   1. Chillers
   2. Boilers
   3. Water to Water Heat Pump
   4. Automatic Temperature Control System/Energy Management System.[1]

B. Training shall be performed by a factory-certified professional trainer for five (5) days and at a minimum shall consist of the following:

   1. Controlling, cooperating, and navigating programs.
   2. Maintenance diagnostics, and trouble-shooting.

[1] VE GMP

3. Service repairs.

C. Round-trip to fly from Philadelphia to the training destination plus lodging expenses for the entire duration of the course shall be paid by the Manufacturer if the location of the site where the course is offered is other than in the Philadeplhia/Harrisburg area.

D. Additionally demonstrations and Training for the ATC/EMS System specified in Section 230900 “Instrumentation and Control for HVAC” shall be in addition to this requirements.

END OF SECTION 23 05 00

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

B. Furnish and install control and interlock wiring for the equipment furnished. In general, power wiring and motor starting equipment will be provided under Division 26. Carefully review the contract documents to coordinate the electrical work under Division 23 with the work under Division 26. Where the electrical requirements of the equipment furnished differ from the provisions made under Division 26, make the necessary allowances under Division 23. Where no electrical provisions are made under Division 26, include all necessary electrical work under Division 23. All electrical work performed under Division 23 shall conform to the applicable requirements of Division 26.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

D. Motors sizes are specified with the driven equipment. Motor starting and control equipment is specified either with the motor which is controlled or in an electrical specification section. The Contractor is advised to consult all specification sections to determine responsibility for motors and controls.

E. Motors shall be suitable for use under the conditions and with the equipment to which applied, and designed for operation on the electrical systems specified or indicated.

1. Motor capacities shall be such that the horsepower rating and the rated full-load current will not be exceeded while operating under the specified operating conditions. Under no condition shall the motor current exceed that indicated on the nameplates.
2. Motor sizes noted in the individual equipment specifications are minimum requirements only. It is the responsibility of the equipment manufacturers and of the Contractor to furnish motors, electrical circuits and equipment of ample capacity to operate the equipment without overloading, exceeding the rated full-load current, or overheating at full-load capacity under the most severe operating service of this equipment. Motors shall have sufficient torque to accelerate the total WR2 of the driven equipment to operating speed.
3. Motors shall be continuous duty type and shall operate quietly at all speeds and loads.
4. Motors shall be designed for operation on 60 hertz power service. Unless otherwise specified or shown, motors less than 1/2 horsepower shall be single phase, and motors 1/2 horsepower and larger shall be 3 phase.
5. Motors shall be mounted so that the motor can be removed without removing the entire driven unit.
6. Brake horsepower load requirement at specified duty shall not exceed 85% of nameplate horsepower times NEMA service factor for motors with 1.0 and 1.15 service factors. For water or refrigerant cooled motors driving compressors and where other limits for certain equipment are given, the maximum load percentage shall be 78%, 72%, and 70%, for motors with 1.25, 1.35, and 1.4 service factors, respectively.
7. Unless otherwise indicated, indoor motors shall be open drip-proof with 1.15 service factors and outdoor motors shall be totally enclosed fan-cooled with 1.15 or 1.0 service factor.

D. Single phase motors, smaller than 1/20 horsepower shall be "life-time" ball or sleeve bearing; open, 120 volts, permanent-split capacitor or shaded pole type, minimum efficiency shall comply with the 2015 small motor legislation enacted by the Department of Energy. Provide ECM motors where indicated on the drawings or where specified.

E. Single phase motors 1/20 horsepower and larger, but less than 1/2 horsepower shall be "life-time" ball bearing; for outdoor service with Class A or B insulation, as standard with the motor manufacturer; capacitor start-induction run, permanent split capacitor, or repulsion start-induction run type with minimum efficiency of 70% and a minimum full load power factor of 77%.

F. Three Phase Motors:

1. Except as otherwise specified in the various specification sections, 3 phase motors 1/2 horsepower and larger shall be NEMA Design B squirrel cage induction type meeting the requirements of this paragraph. Insulation shall be Class B or F, as standard with the motor manufacturer; at 40°C ambient temperature. Motors specified for operation at 480, 240, and 208 volts shall be nameplated 460, 230, 200 volts respectively. All motors shall be of the premium efficiency type. Efficiencies at full load for three phase motors shall be not less than the values listed below or as required by ASHRAE 90.1-2013 and IECC-2015.

Motor Nameplate	Minimum Efficiency at Nominal Speed and Rated Load -- 230/460 Volts at 1750 RPM
.74 kW (1 HP) and above to	85.5%
1-1 kW (1-1/2 HP)	86.5%
1.5 Kw (2 HP)	86.5%
2.2 Kw (3 HP)	89.5%
3.7 kW (5 HP)	89.5%
5.6 kW (7-1/2 HP)	91.0%
7.5 kW (10 HP)	91.7%

Motor Nameplate	Minimum Efficiency at Nominal Speed and Rated Load -- 230/460 Volts at 1750 RPM
11.2 kW (15 HP)	93.0%
14.9 kW (20 HP)	93.0%
18.7 kW (25 HP)	93.6%
22.3 kW (30 HP)	94.5%
29.7 kW (40 HP)	94.5%
37.3 KW (50 HP)	94.5%
44.6 kW (60 HP)	95.0%
52.1 kW (75 HP)	95.0%
74.4 kW (100 HP and above)	95.4%

2. Three phase motors 1/2 HP or greater shall be the Premium Efficiency type as manufactured by Reliance Electric Company, Baldor Motor and Drives, General Electric, Lincoln, Gould, Magnetec, Toshiba, Marathon, Siemens, U.S. Electric, Leeson Electric Corporation, ABB, or approved equal. For motors serving equipment being controlled by a variable speed drive, motor shall be inverter-duty-rated and shall be provided with a shaft grounding ring.
3. Minimum full load power factor before power factor correction of horizontal and vertical shaft motors as follows:

1/2 HP	(3600 & 1800 RPM) - 70%
3/4 HP	(3600 & 1800 RPM) - 70%
1, 1-1/2 & 2 HP	(3600 & 1800 RPM) - 79%
3 HP to 250 HP	(3600 & 1800 RPM) - 85%

G. Control of each motor shall be manual or automatic as specified for each in the various mechanical sections. In general, and unless otherwise specified for a particular item in the various mechanical sections of the specifications, motor starters and controls shall be specified and provided under the various electrical sections of these specifications.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer**.**

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
5. Grounding Rings: Provide grounding rings for all motors using variable speed drives including equipment with integral motors and/or variable speed drives (i.e. fans).

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

D. Provide phase loss protection for all three phase motors including compressors and motors controlled by variable speed drives. Phase monitor shall be the auto reset type with time delay, Model ICM450 or as approval equal.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.

3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.
5. Electronically commutated motor (ECM) or ECM as indicated.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type or ECM.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.6 CAPACITORS:

A. Capacitors for power factor correction shall be provided for motors indicated on the electrical drawings and on all motors 5 HP and above. Submit capacitors with equipment which the capacitor is to be connected to. Capacitors shall be connected at the motor terminals and raise the motor power factor to a minimum of 90%. Capacitors shall be sized by motor manufacturer. Capacitors shall have integral fusing and indicating lights on all phases to give visible indication that a fuse has blown.

B. Capacitors shall not use Polychlorinated Biphenyl's (PCB) or mineral oil as a cooling medium. All capacitors shall have NEMA 1 enclosures for indoor mounting and NEMA 3R enclosures for exterior mounting.

C. Coordinate wiring connections to capacitors and motors with the electrical contractor.

D. Do not provide capacitors for motors utilizing variable speed drives.

2.7 VARIABLE SPEED DRIVE:

A. Provide variable speed controllers for system water pumps, heat wheels, all air handling equipment fans and as indicated. All variable speed drives shall be by the same manufacture unless an integral component to the equipment. Refer to specification section 230515 “Variable Frequency Motor Controllers”.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 23 05 15 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes separately enclosed, preassembled, combination variable frequency motor controllers (VFDs), rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

B. All drives shall be furnished by Division 23 for installation by Division 26.

1.3 DEFINITIONS

A. CE: Conformite Europeene (European Compliance).

B. CPT: Control power transformer.

C. DDC: Direct digital control.

D. EMI: Electromagnetic interference.

E. LED: Light-emitting diode.

F. NC: Normally closed.

G. NO: Normally open.

H. OCPD: Overcurrent protective device.

I. PID: Control action, proportional plus integral plus derivative.

J. RFI: Radio-frequency interference.

K. VFD: Variable-frequency motor controller.

1.4 QUALITY ASSURANCE

A. Referenced Standards and Guidelines:

1. Institute of Electrical and Electronic Engineers (IEEE)

   a. IEEE 519-2014, IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems

2. Underwriters Laboratories (as appropriate)

   a. UL 508, 508A, 508C
   b. UL 61800, 61800-5-1, 61800-5-2

c. UL 1995

3. The Association of Electrical Equipment and Medical Imaging Manufacturers (NEMA)
4. NEMA ICS 7-2014, Adjustable Speed Drives

   a. International Electrotechnical Commission (IEC)
   b. EN/IEC 61800

5. National Electric Code (NEC)

   a. NEC 430.120, Adjustable-Speed Drive Systems

6. CSA Group

   a. CSA C22.2 No. 274

7. International Building Code (IBC)

   a. IBC 2018 Seismic – referencing ASCE 7-16 and ICC AC-156

B. Qualifications:

1. Drives shall be UL labeled as a complete assembly. The base VFD shall be UL listed for 100 kA SCCR when installed in accordance with the manufacturer's guidelines.
2. CE Mark – The base drive shall conform to the European Union Electromagnetic Compatibility directive, a requirement for CE marking. The base drive shall meet product standard EN 61800-3 for the First Environment restricted distribution (Category C2).
3. The base drive shall be seismically certified and labeled as such in accordance with the 2018 International Building Code (IBC):

   a. Seismic importance factor of 1.5, and minimum 2.5 SDS rating is required.
   b. Ratings shall be based upon actual shake test data as defined by ICC AC-156, via all three axis of motion.
   c. Seismic certification of equipment and components shall be provided by OSHPD preapproval.

4. The base drive shall be SEMI-F47 certified. The drive must tolerate voltage sags to 50% for up to 0.2 seconds, sags to 70% for up to 0.5 seconds, and sags to 80% for up to one second.

1.5 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFD indicated.

1. Include dimensions and finishes for VFDs.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Drive horsepower shall be minimum size as indicated. Coordinate size with driven equipment manufacturer based on rated motor horsepower and full load amps (FLA).
4. Provide all accessories as integral components to the drive assembly unless noted otherwise on the drive schedule. Entire assembly shall be UL listed and meet NEC. Bypass panels shall be constructed of UL recognized components, assembled in a UL listed enclosure in strict accordance with the NEC for electrical safety. The assembly shall be UL listed.

B. Shop Drawings: For each VFD indicated.

1. Include mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Required working clearances and required area above and around VFDs.
2. Show VFD layout and relationships between electrical components and adjacent structural and mechanical elements.
3. Show support locations, type of support, and weight on each support.
4. Indicate field measurements.

B. Qualification Data: For testing agency.

C. Product Certificates: For each VFD from manufacturer.

D. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519-2014, Guide for Harmonic Content and Control.

1. List all drives
2. Provide simplified one-line diagram indicating Point of Common Coupling (PCC) or approved Harmonic Analysis program with technical description of all inputs and outputs from programs

E. Source quality-control.

1. Testing: Test and inspect VFDs according to requirements in NEMA ICS 61800-2.

   a. Test each VFD while connected to its specified motor.
   b. Verification of Performance: Rate VFDs according to operation of functions and features specified.

2. VFDs will be considered defective if they do not pass tests and inspections.
3. Prepare test and inspection reports.

F. Field quality-control reports.

G. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFDs to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

   a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
   b. Manufacturer's written instructions for setting field-adjustable overload relays.
   c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
   d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
   e. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
   f. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.8 DELIVERY, STORAGE, AND HANDLING

A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller. Contractor may provide temporary electric service for drives with integral heaters in lieu of temporary heating,

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFDs, including clearances between VFDs, and adjacent surfaces and other items.

1.9 WARRANTY

A. When warranties are required, verify with Owner's counsel that special warranties stated in this article are not less than remedies available to Owner under prevailing local laws.

B. Special Warranty: Sixty (60) months from date of substantial completion. Provide certificate from the Manufacturer. Warranty shall include all parts, labor, travel time and expenses. Prorating is not acceptable. Manufacturer certificate shall provide name(s) of warranty providers who can perform onsite warranty service. Local Warranty, Parts, and Maintenance service shall be available within a 2-hour travel time and on record at Manufacturer's toll free 24/365 technical support line. Third party warranty will not be acceptable. Manufacturer agrees to repair or replace VFDs that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of twenty years.

B. Manufacturers: Subject to compliance with requirements, or as acceptable to the Authority, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Allen-Bradley
2. ABB ACH580 Series
3. Danfoss

C. All VFDs shall be of the same manufacturer.

2.2 GENERAL

A. VFDs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A.

C. VFDs supplied to Owner or Owner's Representative, either as separate items to be mounted in the field or shipped to an OEM for factory mounting in packaged systems. The drive manufacturer shall supply the drive and all necessary options as herein specified.

D. VFDs that are manufactured by a third party and "brand labeled" shall not be acceptable.

1. Drive manufacturers who do not build their own power boards and assemblies, or do not have full control of the power board manufacturing and quality control, shall be considered as a "brand labeled" drive.

E. Application: Variable Torque

F. VFD Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide

self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors, as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

G. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection. Sizing based on ratings in equipment schedules.

H. Unit Operating Requirements:

1. Input AC Voltage Tolerance: Full rated output at +10% and -15% percent of VFD input voltage rating. VFD shall continue to operate without faulting from a line of +30% and -35% of nominal voltage.
2. Input AC Voltage Unbalance: Not exceeding 3 percent.
3. Input Frequency Tolerance: 48 to 63 Hz
4. Minimum Efficiency: 98 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
6. Minimum Short-Circuit Current (SCCR) Rating:
   a. Standard: 100 kA
   b. Drives with soft start: 85kA
   c. Drives with individual motor protectors: 50kA
7. Ambient Conditions: VFDs shall be capable of continuous full load operation under the following environmental conditions:
   a. Temperature: Not less than 5 deg F and not exceeding 104 deg F. Operation up to 122 deg F shall be allowed with a 10% reduction from VFD full load current
   b. Humidity: 5 to 95% (non-condensing).
   c. Altitude: 0 - 3300 feet. Operation up to 6600 feet above sea level shall be allowed with a 1% reduction from VFD full load current rating for every 330 feet over 3300 feet above sea level.
8. Vibration Withstand: Comply with ISTA 1A and 1B.
9. Overload Capability: 110% of normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds every minute. The minimum current rating shall meet or exceed the values in the NEC/UL table 430.250 for 4-pole motors. Output Carrier Frequency: Selectable; 1, 2, 4, 8 (12 kHz w/ derate)

I. Inverter Logic: Microprocessor based, 16 bit, isolated from all power circuits.

J. The input current rating of the drive shall not be greater than the output current rating. Per NFPA 70 430.122, drives with higher input current ratings may require the upstream wiring, protection devices, and source transformers to be upsized.

2.3 SEISMIC PERFORMANCE:

A. The entire VFD assembly shall be seismically certified and labeled as such in accordance with the 2018 International Building Code (IBC):

B. VFD manufacturer shall provide Seismic Certification and Installation requirements at time of submittal.

C. Seismic importance factor of 1.5 rating is required and shall be based upon actual shake test data as defined by ICC AC-156.

D. Seismic ratings based upon calculations alone are not acceptable. Certification of Seismic rating must be based on testing done in all three axis of motion.

E. Special seismic certification of equipment and components shall be provided by OSHPD preapproval.

2.4 ENCLOSURES

A. VFD Enclosures: Enclosures shall be UL508, listed as a complete assembly from the factory or shall be evaluated in the field by a Nationally Recognized Testing Laboratory (NRTL) under a field evaluation program.

B. Provide enclosures according to environmental conditions at installed location as indicated below:

1. Dry and Clean Indoor Locations: UL Type (NEMA) 1.
2. Outdoor Locations: UL Type (NEMA) 3R stainless steel construction.
3. Outdoor Corrosive Locations: UL Type (NEMA) 3R Stainless Steel Construction
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: UL Type (NEMA) 12.

C. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFD as "Plenum Rated."

D. For NEMA 250, Type 1; UL 508 component recognized: Supply fan, with composite intake and exhaust grills and filters; 120-V ac; obtained from integral CPT.

E. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

2.5 INTEGRAL DISCONNECT

A. Provide one of the integral disconnect options below:

1. Disconnect Switch with Fuses - Door interlocked, pad-lockable disconnect switch that will disconnect all input power from the drive and all internally mounted options. Drive input fusing is included.

B. All disconnect configurations shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label. Disconnect packages manufactured by anyone other than the drive manufacturer, are not acceptable.

2.6 PANEL-MOUNTED USER INTERFACE KEYPAD

A. All drives shall utilize the same Advanced Control Panel (keypad) user interface.

B. Plain English text

1. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable).
2. Safety interlock and run permissive status shall be displayed using predetermined application specific nomenclature, such as: Damper end switch, smoke alarm, vibration trip, and overpressure.
3. Safety interlock, run permissive, and external fault status shall have the option of additional customized project specific terms, such as: AHU-1 End Switch, Office Smoke Alarm, CT-2 Vibration.

C. The control panel shall include at minimum the followings controls:

1. Four navigation keys (Up, Down, Left, Right) and two soft keys to simplify operation and programming.
2. Hand-Off-Auto selections and manual speed control without having to navigate to a parameter.

3. Fault Reset and Help keys. The Help key shall include assistance for programming and troubleshooting.

D. Multiple Home View screens shall be capable of displaying up to 21 points of information. Customizable modules shall include bar charts, graphs, meters, and data lists. Displays shall provide real time graphical trending of output power, frequency, and current within selectable intervals of 15/30/60 minutes and 24 hours.

E. The control panel shall display the following items on a single screen; output frequency, output current, reference signal, drive name, time, and operating mode (Hand vs Auto, Run vs Stop). Bi-color (red/green) status LED shall be included. Drive (equipment) name shall be customizable.

F. There shall be a built-in time clock in the control panel. The clock shall have a battery backup with 10 years minimum life span. Daylight savings time shall be selectable.

G. I/O Summary display with a single screen shall indicate and provide:

1. The status/values of all analog inputs, analog outputs, digital inputs, and relay outputs. Drives that require access to internal or live components to measure these values, are not acceptable.
2. The programmed function of all analog inputs, analog outputs, digital inputs, and relay outputs.
3. The ability to force individual digital I/O high or low and individual analog I/O to desired value, for increased personal protection during drive commissioning and troubleshooting. Drives that require access to internal or live components to perform these functions, are not acceptable.

H. The drive shall automatically backup parameters to the control panel. In addition to the automatic backup, the drive shall allow two additional unique backup parameter sets to be stored. Backup files shall include a time and date stamp. In the event of a drive failure, the control panel of the original drive can be installed on the replacement drive, and parameters from that control panel can be downloaded into the replacement drive.

I. The control panel shall display local technical support contact information as part of drive fault status.

J. The control panel shall be removable, capable of remote mounting.

K. The control panel shall have the ability to store screen shots that are downloadable via USB.

L. The control panel shall have the ability to display a QR code for quick access to drive information.

M. The LCD screen shall be backlit with the ability to adjust the screen brightness and contrast, with inverted contrast mode. A user-selectable timer shall dim the display and save power when not in use.

N. The control panel shall include assistants specifically designed to facilitate start-up. Assistants shall include: First Start Assistant, Basic Operation, Basic Control, and PID Assistant.

O. Primary settings for HVAC shall provide quick set-up of all parameters and customer interfaces to reduce programming time.

P. The drive shall be able to operate with the control panel removed.

Q. Bluetooth connectivity:

1. The drive shall be provided a Bluetooth Advanced Control Panel. The Bluetooth control panel shall be FCC and QDL (Qualified Design Listing) certified.
2. A free app (iOS and Android) shall replicate the control panel on a mobile device or tablet. The control panel's programming and control functionality shall function on the device. Customizing text, such as AHU-1 End Switch, shall be supported by the device's keyboard.
3. Bluetooth connectivity shall allow uploading, downloading, and emailing of parameter sets.
4. Bluetooth connectivity shall include two pairing modes: Always discoverable with a fixed passcode, and manual discovery with a unique generated passcode every pairing.

5. The Bluetooth antenna shall be in the control panel. Antennas that are integrated in the drive's control board, must include an external antenna, on all drives mounted inside cabinets.
6. Bluetooth connectivity shall be capable of being switched off.

2.7 SECURITY FEATURES

A. The drive manufacture shall clearly define cybersecurity capabilities for their products.

B. The drive shall include password protection against parameter changes.

1. There shall be multiple levels of password protection including: End User, Service, Advanced, and Override.
2. The drive shall support a customer generated unique password between 0 and 99,999,999.
3. The drive shall log an event whenever the drive password has been entered.
4. The drive shall provide a security selection that prevents any "back door" entry. This selection even prevents the drive manufacturer from being able to bypass the security of that drive.
5. A security level shall be available that prevents the drive from being flashed with new firmware.

C. A checksum feature shall be used to notify the owner of unauthorized parameter changes made to the drive. The checksum feature includes two unique values assigned to a specific programming configuration.

1. One checksum value shall represent all user editable parameters in the drive except communication setup parameters. A second checksum value shall represent all user editable parameters except communication setup, energy, and motor data parameters.
2. Once the drive has been commissioned the two values can be independently saved in the drive.
3. The drive shall be configurable to either: Log an Event, provide a Warning, or Fault upon a parameter change when the current checksum value does not equal the saved checksum value.

D. The "Hand" and "Off" control panel buttons shall have the option to be individually disabled (via parameter) for drives mounted in public areas.

E. The capability to disable Bluetooth on control panels that include Bluetooth functionality shall be provided.

2.8 NETWORK COMMUNICATIONS

A. The drive shall have an EIA-485 port with removable terminal blocks. The onboard protocols shall be BACnet MS/TP, optional communication cards for BACnet/IP, LonWorks, Profibus, Profinet, EtherNet/IP, Modbus TCP, and DeviceNet shall be available. The use of third party gateways are not acceptable.

B. The drive shall have the ability to communicate via two protocols at the same time, one onboard protocol and one option card based protocol. Once installed, the drive shall automatically recognize any optional communication cards without the need for additional programming.

C. The drive shall not require a power cycle after communication parameters have been updated.

D. The embedded BACnet connection shall be a MS/TP interface. The drive shall be BTL Listed to Revision 14 or later. Use of non-BTL Listed drives are not acceptable.

E. The drive shall be classified as an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:

1. Data Sharing: Read Property Multiple-B, Write Property Multiple-B, COV-B
2. Device Management: Time Synchronization-B
3. Object Type Support: MSV, Loop

F. The drive's relay output status, digital input status, analog input/output values, Hand-Auto status, warning and fault information shall be capable of being monitored over the network. The drive's start/stop command,

speed reference command, relay outputs and analog outputs shall be capable of being controlled over the network. Remote drive fault reset shall be possible.

2.9 SOFTWARE FEATURES:

A. A Fault Logger that stores the last 16 faults in non-volatile memory.

1. The most recent 5 faults save at least 9 data points, including but not limited to: Time/date, frequency, DC bus voltage, motor current, DI status, temperature, and status words.
2. The date and time of each fault and fault reset attempt shall be stored in the Fault Logger.

B. An Event Logger that stores the last 16 warnings or events that occurred, in non-volatile memory.

1. Events shall include, but not limited to: Warning messages, checksum mismatch, run permissive open, start interlock open, and automatic reset of a fault.
2. The date and time of each event's start and completion points shall be stored in the Event Logger.

C. Programmable start method. Start method shall be selectable based on the application: Flying-start, Normal-start, and Brake-on-start.

D. Programmable loss-of-load (broken belt / coupling) indication. Indication shall be selectable as a control panel warning, relay output, or over network communications. This function to include a programmable time delay to eliminate false loss-of-load indications.

E. Motor heating function to prevent condensation build up in the motor. Motor heating adjustment, via parameter, shall be in "Watts." Heating functions based only on "percent current" are not acceptable.

F. Advanced power metering abilities shall be included in the drive. Drives without these data points, must include a separate power meter with each drive.

1. Instantaneous output power (kW)
2. Total power broken down by kWh, MWh, and GWh units of measurement. Power meters that only display kWh and roll over or "max out" once the maximum kWh value is reached, are not acceptable. There shall be resettable and non-resettable total power meters within the drive.
3. Time based kWh metering for: current hour, previous hour, current day, and previous day.
4. Energy saving calculation shall be included that shows the energy and dollars saved by the drive.

G. The drive shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise.

H. Run permissive circuit - There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command, the Drives shall provide a dry contact closure that will signal the damper to open. When the damper is fully open, an end-switch shall close, allowing the drive to run the motor.

1. The drive shall also include a programmable start delay, for when an end-switch is not provided.

I. Start interlock circuit - Four separate start interlock (safety) inputs shall be provided. When any safety is opened, the motor shall be commanded to stop. The control panel will display the specific safety(s) that are open. The status of each safety shall be transmitted over the network communications. Wiring multiple safeties in series is not acceptable.

J. External fault circuit – Three separate external fault inputs shall be provided. This circuit shall have the same features and functionality as the start interlock circuit, except it shall require a manual reset before the drive is allowed to operate the motor.

K. The drive shall include a switching frequency control circuit that reduces the switching frequency based on actual drive temperature, and allows higher switching frequency settings without derating the drive. It shall be possible to set a minimum and a target switching frequency.

L. Visual function block adaptive programming allowing custom control schemes, minimizing the need for external controllers. I.e. cooling tower staging logic. A free software tool shall be used to configure adaptive programming.

M. The ability to automatically restart after an over-current, over-voltage, under-voltage, external fault, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable. Each of these faults may have automatic restart individually disabled via a parameter selection.

N. Three (3) programmable critical frequency lockout ranges to prevent the drive from operating the load continuously at an unstable speed/load.

O. Seven (7) programmable preset frequencies/speeds.

P. Two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps.

Q. PID functionality shall be included in the drive.

1. Programmable “Sleep” and “Wake up” functions to allow the drive to be started and stopped based on the level of a process feedback signal.
2. The drive shall include an independent PID loop for customer use, assigned to an analog output. This PID loop may be used for cooling tower bypass valve control, chilled water valve, etc.

R. At least 4 parameter user sets that can be saved to the permanent memory and recalled using a digital input, timed function, or supervision function.

S. Drive shall be compatible with an accessory that allows the control board to be powered from an external 24 VDC/VAC source, allowing the drive control to remain powered by a UPS during an extended power outage.

T. A computer-based software tool shall be available to allow a laptop to program the drive. The drive shall be able to support programming without the need for line voltage. All necessary power shall be sourced via the laptop USB port.

U. The drive shall include a fireman’s override mode. Upon receipt of a contact closure from the Fire Alarm Life Safety system, the drive shall operate in a dedicated Override mode distinct and separate from the drive’s Normal operation mode. The following features will be available in the drive override function:

1. The Override mode shall be secured by password to prevent changes once programmed.
2. The drive shall ignore external inputs and commands not defined as part of the override function.
3. Override operation mode shall be selectable between: single frequency, multiple fixed frequencies, follow an analog input signal, PID control, or come to a forced stop.
4. High priority safeties shall stop the drive and lower priority safeties shall be ignored in Override mode.
5. Drive faults shall be defined in Critical and Low priority groups. Critical faults shall stop the drive. Low priority faults shall be reset. Reset trials and timing shall be programmable.
6. The drive shall be configurable to receive from 1 to 3 discrete digital input signals and operate at up to three discrete speeds.

V. The drive shall have multi-pump functionality and an intelligent master/follower configuration for controlling up to 8 parallel pumps equipped with drives. The drive shall have a parameter synchronization feature to program the PID, multi-pump, and AI parameters in all parallel drives. The functionality to start and stop the pumps based on capacity, operating time or efficiency of the pump to ensure each pump is operated regularly.

W. The multi-pump functionality shall control:

1. Flow Control
2. Pressure Control
3. Pump Alternation

2.10 HARDWARE FEATURE

A. Electric Input Signal Interface:

1. A minimum of two programmable analog inputs: 0- to 10-V dc or 4- to 20-mA selectable via control panel.
2. A minimum of six programmable digital inputs: All digital inputs shall be programmable to support both active high and active low logic and shall include adjustable on/off time delays. The digital input shall be capable of accepting both 24 VDC and 24 VAC.
3. A minimum of two programmable analog outputs: 0- to 10-V dc or 4- to 20-mA.
4. A minimum of three programmable Form-C relay outputs. The relay outputs shall include programmable on/off time delays. The relays shall be rated for a continuous current rating of 2 Amps. Maximum switching voltage of 250 VAC / 30 VDC. Open collector and Form-A relays are not acceptable. Drives that have less than (3) Form-C relay outputs shall provide an option card to provide additional relay outputs.

B. Drive terminal blocks shall be color coded for easy identification of function.

C. The drive shall include an isolated USB port for interface between the drive and a laptop. A non-isolated USB port is not acceptable.

D. An auxiliary power supply rated at 24 VDC, 250 mA shall be included.

E. The drive shall have cooling fans that are designed for field replacement. The primary cooling fan shall operate only when required and be variable speed for increased longevity and lower noise levels. Drives whose primary cooling fans are not variable speed, shall include a spare cooling fan.

F. Circuit boards shall be coated per IEC 60721-3-3; Chemical gasses Class 3C2 and Solid particles Class 3S2.

G. Earth (ground) fault detection shall function in both modulating (running) and non-modulating modes.

H. Coordinated AC transient surge protection system consisting of 4 MOVs (phase-to-phase and phase-to-ground), a capacitor clamp, and internal chokes. The MOVs shall comply with UL 1449 4th Edition. Drives that do not include coordinated AC transient surge protection shall include an external TVSS/SPD (Transient Voltage Surge Suppressor/Surge Protection Device).

I. The drive shall include a robust DC bus to provide short term power-loss ride through. The DC bus Joule to drive kVA ratio shall be 4.5 J/kVA or higher. An inertia-based ride through function should help maintain the DC bus voltage during power loss events. Drives with control power ride through only, are not acceptable.

J. Drives serving multiple motors (i.e. fan arrays) shall contain individual manual motor protectors (MMP) for all motors served by drive. MMPs shall be sized based on the rated motor amperage. Refer to mechanical schedules for quantity and horsepower of motors.

a. Provide MMP Common fault output
b. Provide MMP status pilot lights on VFD enclosure.

2.11 HARMONIC CONDITIONING AND LINE FILTERING

A. Input Line Conditioning:

1. Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE 519-2014 recommendations.
2. At a minimum, the drives shall have internal impedance equivalent to 5% to reduce the harmonics to the power line. 5% impedance may be from dual (positive and negative DC link) chokes, or AC line reactor. Drives with only one DC link choke shall add an AC line reactor integral to the drive enclosure.

3. Provide additional harmonic filtration mitigation devices as required to meet IEEE 519-2014. Acceptable additional harmonic filtration devices include:

   a. Integral AC Line Reactors
   b. Integral passive harmonic filters
   c. Active front End:
      1) An IGBT based active front end shall be used for mitigation of low frequency harmonics. A LCL filter shall be installed in front of the IGBTs to remove high frequency harmonics.
      2) Limit the current distortion to 3% total harmonic current distortion, when measured at the lugs of the drive.
      3) The drive shall provide full motor nameplate voltage while operating the motor at nameplate RPM. The output IGBTs must be modulating and in control of the motor during this 100% speed/load operating condition. The specified 3% current distortion and 1.0 displacement power factor shall be achievable during this operating condition.
      4) The hardware structure of the front end shall boost the DC bus voltage by 10% during low line conditions.
      5) Displacement power factor shall be 1.0 throughout the speed range.
   d. 12 pulse or 18 pulse PWM design

B. Output Filtering: Provide dV/dT output filters on load side of drive for motor protection where length exceeds motor manufacturer recommendations or 100 feet, whichever is smaller.

C. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for First Environment restricted level (Category C2) with up to 100 feet of motor cable.

2.12 BYPASS SYSTEMS

A. Provide single enclosure containing a variable frequency drive and bypass system. All VFD with bypass configurations shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508 label. Bypasses manufactured by anyone other than the drive manufacturer, are not acceptable.

B. Description: Complete factory wired and tested bypass system consisting of a door interlocked, pad-lockable disconnecting device, output contactor, bypass contactor, and fast acting VFD isolation fuses. UL Listed motor overload protection shall be provided in both drive and bypass modes.

C. Bypass Configuration: Two-contactor-style (bypass and output) bypass allowing motor operation via the power converter or the bypass controller; with input isolating switch arranged to isolate the power converter and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.

   1. Bypass Contactor: Load-break, IEC-rated contactor.
   2. Output Isolating Contactor: Non-load-break, IEC-rated contactor.
   3. Drive Isolation Fuses: Fast acting fuses shall be provided to disconnect the VFD from the line prior to clearing upstream branch circuit protection to maintain bypass operation capability in the event of a VFD failure. Bypass designs which have no such fuses, or that incorporate fuses common to both the VFD and the bypass, will not be accepted. Third contactor “isolation contactors” are not an acceptable alternative to fuses, as contactors could weld closed and are not an NEC recognized disconnecting device.
   4. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode.
   5. The bypass shall maintain positive contactor control through the voltage tolerance window of nominal voltage +30%, -35% to avoid contactor coil failure during brown out / low line conditions and allow for input single phase operation when in the VFD mode. Single-phase power supplies and control power transformers (CPT) are not acceptable.

D. Bypass Type

   1. Less than 75 horsepower: Full-voltage (across-the-line) non-reversing.

2. 75 horsepower and above: Reduced voltage soft start.

E. Bypass Controller:

1. Bypass Mode shall be field-selectable Automatic or Manual to allow local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic-control system feedback.
2. The bypass system shall be designed for stand-alone operation and shall be completely functional in both Manual and Automatic modes even if the VFD has been removed from the system for repair / replacement.
3. Motor protection from single phase power conditions: The bypass system must be able to detect a single phase input power condition while running in bypass, disengage the motor in a controlled fashion, and give a single phase input power indication. Bypass systems not incorporating single phase protection in bypass mode are not acceptable.
4. Bypass shall include Six (6) digital inputs and five (5) Form-C relay outputs. The digital inputs shall be capable of accepting both 24 VDC and 24 VAC. The bypass control board shall include an auxiliary power supply rated 24 VDC, 250 mA.
5. Network communications – the bypass shall include BACnet MS/TP, Modbus, and Johnson Controls N2 as standard. The bypass BACnet implementation shall be BTL Listed to Revision 14 or later. Optional communication cards for BACnet/IP, LonWorks, Profibus, Profinet, Ethernet/IP, Modbus TCP, and DeviceNet shall be available. Serial communications shall remain functional even with the VFD removed. Bypass systems that do not maintain full functionality with the drive removed are not acceptable.

   a. The bypass relay output status, digital input status, warning and fault information can be monitored over the network. Status information shall be monitored, including; operating mode (drive vs bypass), current drawn in bypass mode, broken belt, and phase-to-phase voltage. The bypass start/stop command, force to bypass command, and relay outputs shall be capable of being controlled over the network.

F. All bypass packages shall utilize a dedicated LCD bypass control panel (keypad) user interface. The bypass control panel must be a separate display from the drive control panel. Bypass packages that use a single shared drive/bypass control panel are not acceptable, due to that control panel acting as a single point of failure.

1. The bypass shall include a two-line, 20-character LCD display. The display shall allow the user to access parameters and view:

   a. Bypass input voltage, current (Amps) and power (kW)
   b. Bypass faults, warnings, and fault logs
   c. Bypass operating time and energy consumption (resettable)

2. The bypass control panel shall include the following controls:

   a. Four navigation keys (Up, Down, Enter, Escape)
   b. Bypass Hand-Off-Auto, Drive mode / Bypass mode selectors, Bypass fault reset

3. The following indicating lights (LED PTT type) or control panel display indications shall be provided.

   a. Drive mode selected, Bypass mode selected
   b. Drive running, Bypass running
   c. Drive fault, Bypass fault

4. Safety interlock and run permissive status shall be displayed using predetermined application specific nomenclature, such as: Damper end switch, smoke alarm, vibration trip, and overpressure.

G. All bypasses shall have the following software features as standard:

1. Programmable loss-of-load (broken belt / coupling) indication shall be functional in drive and bypass mode.
2. The bypass shall also support run permissive and start interlock control functionality, including start delay, as previously specified in the drive section.
3. The bypass control shall monitor the status of the drive and bypass contactors and indicate when there is a welded contactor contact or open contactor coil.

4. The bypass shall include a selection for either manual or automatic transfer to bypass. The automatic transfer mode shall allow the user to select the specific drive fault types that result in an automatic transfer to bypass. The automatic transfer mode shall not allow a transfer to bypass on motor related faults. Automatic transfer schemes that do not differentiate between fault types, are not acceptable.
5. The bypass shall include the ability to select the operating mode of the system (Drive/Bypass) from either the bypass control panel or digital input.
6. The bypass shall include a supervisory control mode that monitors the value of the drive's analog input (feedback). This feedback value is used to control the bypass contactor on/off state. The supervisory mode shall allow the user to maintain hysteresis control over applications such as cooling towers and booster pumps.
7. Selectable Class 10, 20, or 30 electronic motor overload protection shall be included in both drive and bypass mode.
8. The drive and bypass shall be designed to operate as an integrated system when in Override mode. Whether operating in drive or bypass mode, the low priority safeties will be ignored, and high priority safeties will be followed. External start/stop commands will be ignored. There shall be four selectable Override modes:

    a. Bypass only, with two smoke control modes:
        1) Fixed pre-configuration of digital inputs
        2) Configurable high/low priority safeties and faults, to allow configuration to meet needs of local Authority Having Jurisdiction.

    b. Drive only
    c. Drive then transfer to bypass, in the event of a drive fault
    d. Force to Stop

H. The bypass shall provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in VFD or Bypass mode. The remote start/stop contact shall operate in VFD and bypass modes. The terminal strip shall allow for independent connection of up to four (4) unique safety inputs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFDs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.

B. Examine VFD before installation. Reject VFDs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD installation.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in each fusible-switch VFD.

D. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."

E. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.

F. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

G. Comply with NECA 1.

3.3 POWER WIRING INSTALLATION

A. Install Type TC-ER shielded cable from variable-frequency controller to related motor.

3.4 CONTROL WIRING INSTALLATION

A. Bundle, train, and support wiring in enclosures.

B. Connect selector switches and other automatic-control devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.
2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

3.5 IDENTIFICATION

A. Identify VFDs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each VFD with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for VFDs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFD units.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify the Authority before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

E. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

F. Set field-adjustable pressure switches.

3.8 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFDs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train the Authority's maintenance personnel to adjust, operate, reprogram, and maintain VFDs.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Testing Agency Qualifications: Member Company of NETA or an NRTL.
2. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing. Provide factory authorized technician to certify VFD’s for full manufacturer’s warranty.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each VFD element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Inspect VFD, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each VFD element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at VFD locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify the Authority before starting the motor(s).
5. Test each motor for proper phase rotation.

6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared (thermographic) scan tests and inspections, and prepare reports:
    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFD. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each VFD 11 months after date of Substantial Completion.
    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. VFDs will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies the VFD and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

END OF SECTION

SECTION 23 05 19 - METERS AND GAUGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Liquid in glass thermometers.
2. Thermowells.
3. Dial-type pressure gauges.
4. Gauge attachments.
5. Test plugs.
6. Test-plug kits.
7. Sight flow indicators.
8. Pitot-tube flowmeters.

B. Related Sections:

1. Division 23 Section "Facility Natural-Gas Piping" for gas meters.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Wiring Diagrams: For power, signal, and control wiring.

C. Product Certificates: For each type of meter and gauge, from manufacturer.

D. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial Style, Liquid-in-Glass Thermometers.
1. Basis-of-Design Product: Subject to compliance with requirements, provide H.O. Trerice Model BX9 Industrial thermometer or comparable product by one of the following:
   a. Ashcroft, Inc.
   b. Miljoco Corporation.
   c. Trerice, H.O. Co.
   d. Weiss Instruments, Inc.
2. Standard: ASME B40.200.
3. Case: Cast aluminum 9-inch (229-mm) nominal size unless otherwise indicated.
4. Case Form: Back angle unless otherwise indicated.

5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in deg F (deg C).
7. Window: Glass.
8. Stem: Brass adjustable angle, brass stem and of length to suit installation.
   a. Design for Air-Duct Installation: With ventilated shroud.
   b. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: Brass.
4. Material for Use with Steel Piping: Brass.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

C. Where wells are installed in pipe tees at turns, increase pipe size so that well does not restrict flow.

2.4 PRESSURE GAUGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Trerice, Model 600C, or comparable product by one of the following:
   a. Ashcroft Inc.
   b. Ernst Flow Industries.
   c. Miljoco Corporation.
   d. Noshok.
   e. Weiss Instruments, Inc.

2. Standard: ASME B40.100.
3. Case: Sealed, type(s); cast aluminum or drawn steel; 4-1/2-inch (114-mm) nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).
8. Pointer: Dark-colored metal.

9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Remote-Mounted, Metal-Case, Dial-Type Pressure Gauges:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Trerice Industrial, or comparable product by one of the following:
   a. Ashcroft Inc.
   b. Ernst Flow Industries.
   c. Miljoco Corporation.
   d. Noshok.
   e. Weiss Instruments, Inc.

2. Standard: ASME B40.100.
3. Case: Cast aluminum or drawn steel, 4-1/2-inch (114-mm), nominal diameter with back flange and holes for panel mounting.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAUGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass ball valve with stainless steel trim, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads.

2.6 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 (DN 8) or NPS 1/2 (DN 15), ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 300 psig at 250 deg F (2070 kPa at 121 deg C).

F. Core Inserts: EPDM self-sealing rubber.

2.7 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gauge and adapter, and carrying case. Thermometer sensing elements, pressure gauge, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F (minus 4 to plus 52 deg C).

D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F (minus 18 to plus 104 deg C).

E. Pressure Gauge: Small, Bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be at least 0 to 200 psig (0 to 1380 kPa).

F. Carrying Case: Metal or plastic, with formed instrument padding.

2.8 SIGHT FLOW INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Archon Industries, Inc.
2. Dwyer Instruments, Inc.
3. Emerson Process Management; Brooks Instrument.
4. Ernst Co., John C., Inc.
5. Ernst Flow Industries.
6. KOBOLD Instruments, Inc. - USA; KOBOLD Messring GmbH.
7. OPW Engineered Systems; a Dover company.
8. Penberthy; A Brand of Tyco Valves & Controls - Prophetstown.

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

D. Minimum Pressure Rating: 125 psig (860 kPa).

E. Minimum Temperature Rating: 200 deg F (93 deg C).

F. End Connections for NPS 2 (DN 50) and Smaller: Threaded.

G. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

2.9 FLOWMETERS

A. Venturi Flowmeters:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Preso Meters or comparable product by one of the following:

   a. ABB; Instrumentation and Analytical.
   b. Gerand Engineering Co.
   c. Hyspan Precision Products, Inc.
   d. S. A. Armstrong Limited; Armstrong Pumps Inc.

2. Description: Flowmeter with calibrated flow-measuring element, hoses or tubing, fittings, valves, indicator, and conversion chart.
3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
4. Sensor: Venturi-type, calibrated, flow-measuring element; for installation in piping.

   a. Design: Differential-pressure-type measurement for water.
   b. Construction: Bronze, brass, or factory-primed steel, with brass fittings and attached tag with flow conversion data.
   c. Minimum Pressure Rating: 250 psig (1725 kPa).
   d. Minimum Temperature Rating: 250 deg F (121 deg C).
   e. End Connections for NPS 2 (DN 50) and Smaller: Threaded.
   f. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged or welded.
   g. Flow Range: Flow-measuring element and flowmeter shall cover operating range of equipment or system served.

5. Permanent Indicators: Meter suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch- (152-mm-) diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.

   a. Scale: Gallons per minute (Liters per second).
   b. Accuracy: Plus or minus 1 percent between 20 and 80 percent of scale range.

6. Portable Indicators: Hand-held, differential-pressure type, calibrated for connected flowmeter element and having two 12-foot (3.7-m) hoses, with carrying case.

   a. Scale: Gallons per minute (Liters per second).
   b. Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range.

7. Display: Shows rate of flow.
8. Conversion Chart: Flow rate data compatible with sensor.
9. Operating Instructions: Include complete instructions with each flowmeter.

2.10 FLOW AND THERMAL-ENERGY METERS:

A. Electro Magnetic, Thermal-Energy Meters:

B. Basis-of-Design Product: Subject to compliance with requirements, provide Onicon F3200 Series or as indicated on the drawings with System 10 BTU Meter or comparable product by one of the following:
1. Data Industrial Corp.
2. Hoffer Flow Controls, Inc.
3. ISTEC Corporation.
4. ONICON Incorporated.

C. Description: System with flow sensor, temperature sensors, transmitter, indicator, and connecting wiring.

D. Flow Sensor: In-Line Electromagnetic type with corrosion-resistant-metal body and transmitter; for installing in piping.

E. Design: Total thermal-energy measurement.

F. Minimum Pressure Rating: 150 psig (1035 kPa).

G. Minimum Temperature Range: 32 to 200 deg F.

H. Temperature Sensors: Insertion-type transducer.

I. Indicator: Solid-state, integrating-type meter with integral battery pack; for wall mounting.

J. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units (joules).

K. Battery Pack: Five-year lithium battery.

L. Accuracy: Plus or minus 2 percent of rate over an extended 50:1 turndown range.

M. Display: Visually indicates total fluid volume in gallons and thermal-energy flow in British thermal units.

N. Strainer: Full size of main line piping.

O. Operating Instructions: Include complete instructions with each thermal-energy meter system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

H. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.

I. Install remote-mounted pressure gauges on panel.

J. Install valve and snubber in piping for each pressure gauge for fluids (except steam).

K. Install valve and syphon fitting in piping for each pressure gauge for steam.

L. Install test plugs in piping tees.

M. Install flow indicators in piping systems in accessible positions for easy viewing.

N. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

O. Install flowmeter elements in accessible positions in piping systems.

P. Install wafer-orifice flowmeter elements between pipe flanges.

Q. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

R. Install permanent indicators on walls or brackets in accessible and readable positions.

S. Install connection fittings in accessible locations for attachment to portable indicators.

T. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.

U. Install thermometers in the following locations:

1. Inlet and outlet of each boiler and chiller.
2. Inlet and outlet of each hydronic coil in air-handling units.
3. Two inlets and two outlets of each hydronic heat exchanger.
4. Outside-, return-, supply-, and mixed-air ducts.
5. Where indicated on the Drawings.

V. Install pressure gauges in the following locations:

1. Discharge of each pressure-reducing valve.
2. Inlet and outlet of each boiler and chiller.
3. Suction and discharge of each pump.
4. Inlet and Outlet of each hydronic coil.
5. Where indicated on the Drawings.

3.2 CONNECTIONS

A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance of meters, gauges, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy meter transmitters to meters.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gauges to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlets and outlets of each boiler and chiller shall be the following:
1. Industrial Style, liquid in glass type.

B. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be the following:
   1. Industrial Style, liquid in glass type.

C. Thermometers at inlets and outlets of each hydronic heat exchanger shall be the following:
   1. Industrial Style, liquid in glass type.

D. Thermometers at outside-, return-, supply-, and mixed-air ducts shall be the following:
   1. Direct-mounted, metal-case, vapor-actuated type.

E. Thermometers at terminal units:
   1. Test Plug with EPDM self-sealing rubber inserts.

F. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Heating, Hot-Water Piping: 20 to 240 deg F.

B. Scale Range for Cooling, Chilled Water Piping: 25 deg F to 125 deg F.

C. Scale Range for Air Ducts: 0 deg F to 160 deg F.

3.6 PRESSURE-GAUGE SCHEDULE

A. Pressure gauges at discharge of each pressure-reducing valve shall be the following:
   1. Metal case, direct-mounted, dial type.

B. Pressure gauges at inlet and outlet of each chiller and boiler connection shall be the following:
   1. Metal case, direct-mounted, dial type.

C. Pressure gauges at inlet and outlet of each terminal unit (fan coil unit, cabinet unit heater, unit heater, baseboard radiation, convector, etc.) coil connection shall be the following:
   1. Test plug with EPDM self-sealing rubber inserts.

D. Pressure gauges at suction and discharge of each pump shall be the following:
   1. Metal case, direct-mounted, dial type.

E. Pressure gauges at inlet and outlet of each air handling and/or heat recovery unit shall be the following:
   1. Metal case, direct-mounted, dial type.

3.7 PRESSURE-GAUGE SCALE-RANGE SCHEDULE

A. Scale Range for Cooling, Chilled-Water Piping: 0 to 100 psi (0 to 700 kPa).

B. Scale Range for Heating, Hot-Water Piping: 0 to 100 psi (0 to 700 kPa).

3.8 MANUAL FLOWMETER SCHEDULE

A. Flowmeters for Cooling, Chilled-Water Piping: Venturi type.

B. Flowmeters for Heating, Hot-Water Piping: Venturi type.

3.9 AUTOMATIC FLOWMETERS AND ENERGY METER SCHEDULE:

A. Thermal energy meters for chilled water piping: Electromagnetic type.

B. Thermal energy meters for heating water piping: Electromagnetic type.

C. Flow meter for makeup water piping: Electromagnetic type.

END OF SECTION 23 05 19

SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze angle valves.
2. Bronze ball valves.
3. High-performance butterfly valves.
4. Bronze swing check valves.
5. Iron swing check valves.
6. Bronze globe valves.
7. Iron globe valves.
8. Eccentric plug valves.
9. Chainwheels.

B. Related Sections:

1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, and globe valves closed to prevent rattling.
4. Set ball valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 4” and larger.
2. Handlever: For quarter-turn valves NPS 3” and smaller.
3. Wrench: For plug valves with square heads. Furnish Owner with one (1) wrench for every plug valve.
4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:
1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
2. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Threaded: With threads according to ASME B1.20.1.
3. Solder Joint: With sockets according to ASME B16.18.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

A. Class 125, Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Hammond Valve.
   b. Milwaukee Valve Company.
   c. Crane.
   d. Watts.
   e. Apollo.

2. Description:

   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 200 psig (1380 kPa).
   c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
   d. Ends: Threaded.
   e. Stem and Disc: Bronze.
   f. Packing: Asbestos free.
   g. Handwheel: Malleable iron or bronze.

B. Class 150, Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Crane Co.; Crane Valve Group; Stockham Division.
   b. Kitz Corporation.

2. Description:

   a. Standard: MSS SP-80, Type 1.
   b. CWP Rating: 300 psig (2070 kPa).
   c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
   d. Ends: Threaded.
   e. Stem and Disc: Bronze.
   f. Packing: Asbestos free.
   g. Handwheel: Malleable iron.

2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Conbraco Industries, Inc.; Apollo Valves.
   b. Crane Co.; Crane Valve Group; Crane Valves.
   c. Hammond Valve.
   d. Milwaukee Valve Company.
   e. Jamesbury.
   f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   g. Nibco.

2. Description:

   a. Standard: MSS SP-110.
   b. SWP Rating: 150 psig (1035 kPa).
   c. CWP Rating: 600 psig (4140 kPa).
   d. Body Design: Two piece.
   e. Body Material: Bronze.
   f. Ends: Threaded (soldered for copper piping).
   g. Seats: RPTFE.
   h. Stem: 316 Stainless steel.
   i. Ball: 316 Stainless steel, vented.

j. Port: Full.
k. Where used for balancing, provide memory stop and latch lock. Provide round handle where lever handle will not fit.

B. Where used for balancing, provide memory stop and latch lock. Provide round handle

2.4 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, High-Performance Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bray Controls; a division of Bray International – Series 41.
b. DeZurik Water Controls – Series BHP
c. Jamesbury; a subsidiary of Metso Automation – Series 815L.
d. Milwaukee Valve Company – Series HP1 LCS.
e. Keystone Series K-Loc.

2. Description:

a. Standard: MSS SP-68.
b. CWP Rating: 285 psig (1965 kPa) at 100 deg F (38 deg C).
c. Body Design: Lug type; suitable for bidirectional with bubble tight shut-off for dead-end service at rated pressure without use of downstream flange.
d. Body Material: Carbon steel.
e. Seat: Reinforced PTFE.
f. Stem: Blow-out-proof, stainless steel; offset from seat plane.
g. Disc: 316 Stainless steel, ASTM A 351, Grade CF8m.
h. Service: Bidirectional.
i. Operator: gear operator.

2.5 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Division.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded (soldered for copper piping).
f. Disc: Bronze.

2.6 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Company; Crane Valve Group; Crane Valves.

b. Crane Company; Crane Valve Group; Jenkins Valves.
c. Crane Company; Crane Valve Group; Stockham Division.
d. Milwaukee Valve Company.
e. Watts Regulator Company; a Division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating; 200 psig (1380 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating; 150 psig (1035 kPa).
d. Body Design: Clear or full waterway.
e. Body Material: ASTM A 126, gray iron with bolted bonnet.
f. Ends: Flanged.
g. Trim: Bronze.
h. Gasket: Asbestos free.

B. Class 250, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 500 psig (3450 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 300 psig (2070 kPa).
d. Body Design: Clear or full waterway.
e. Body Material: ASTM A 126, gray iron with bolted bonnet.
f. Ends: Flanged.
g. Trim: Bronze.
h. Gasket: Asbestos free.

2.7 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Division.
d. Hammond Valve.
e. Milwaukee Valve Company.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-85, Type I.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Packing and Gasket: Asbestos free.

2.8 ECCENTRIC PLUG MANUAL (BALANCING) VALVES

A. 175 CWP, Eccentric Plug Valves with Resilient Seating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. DeZurik Water Controls.
b. Homestead Valve; a division of Olson Technologies, Inc.
c. Milliken Valve Company.

2. Description:

a. Standard: MSS SP-108.
b. CWP Rating: 175 psig (1200 kPa) minimum.
c. Body and Plug: ASTM A 48/A 48M, gray iron; ASTM A 126, gray iron; or ASTM A 536, ductile iron.
d. Bearings: Permanently lubricated 316 stainless steel.
e. Ends: Flanged.
f. Stem-Seal Packing: Asbestos free.
g. Plug, Resilient-Seating Material: EPDM suitable for potable-water service unless otherwise indicated.

2.9 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to ball, butterfly and globe valve stems.
3. Sprocket Rim with Chain Guides: Hot dip galvanized steel, of type and size required for valve.
4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for ball, butterfly, and globe valves NPS 4 (DN 100) and larger and more than 8'-0" or greater above floor. Extend chains to 72 inches (1824 mm) above finished floor.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly, or plug valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Throttling Service: Globe, ball, plug, or butterfly valves.
4. Pump-Discharge Check Valves:

   a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze disc.
   b. NPS 2-1/2 (DN 65) and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal -seat check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.

3.5 CHILLED WATER VALVE SCHEDULE:

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Valves: Provide with threaded or solder joint ends.
2. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
3. Bronze Swing Check Valves: Class 150, bronze disc.

4. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves: Provide with flanged ends.
2. Bronze Ball Valves, NPS 2-1/2 to NPS 3: Class 125 with threaded ends.
3. High-Performance Butterfly Valves, 4” and larger: Class 150, lug style.
4. Iron Swing Check Valves: Class 125 nonmetallic-to-metal seats.
5. Iron Globe Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): Class 125.
6. Eccentric Plug Valves: 175 CWP, resilient seating.

3.6 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two-piece, full port, bronze with stainless-steel trim.
3. Bronze Swing Check Valves: Class 150, bronze disc.
4. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves: Provide with flanged ends.
2. Bronze Ball Valves, full port, stainless steel trim, NPS 2-1/2 to NPS 3: Class 125.
3. High-Performance Butterfly Valves, 4” and larger: Class 150, lug style.
4. Iron Swing Check Valves: Class 125 nonmetallic-to-metal seats.
5. Iron Globe Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): Class 125.
6. Eccentric Plug Valves: 175 CWP, resilient seating.

END OF SECTION

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Pipe stands.
6. Equipment supports.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Division 23 Section "Vibration Controls for HVAC Piping and Equipment" for vibration isolation devices.
4. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

C. Delegated-Design Submittal: For hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

D. Welding certificates.

1.6 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel or zinc-plated carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components. Provide felt or wool inserts.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel or copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 stainless steel or zinc-plated carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.
   c. Flex-Strut Inc.
   d. GS Metals Corp.
   e. Thomas & Betts Corporation.
   f. Unistrut Corporation; Tyco International, Ltd.
   g. Wesanco, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel or zinc-coated stainless steel.
7. Metallic Coating: Hot-dipped galvanized.
8. Paint Coating: Rust-inhibiting paint.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by Anvil International, Figure 45 Channel Assembly or comparable product by one of the following:

   a. Empire Industries, Inc.
   b. ERICO International Corporation.
   c. Haydon Corporation; H-Strut Division.
   d. PHD Manufacturing, Inc.
   e. PHS Industries, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous steel channel assembly with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel or zinc-coated carbon steel.
7. Coating: Rust-inhibiting paint or galvanized.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by Anvil International, Figure 45 Channel Assembly, or comparable product by one of the following:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Rilco Manufacturing Co., Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass, fiberglass blocks or calcium silicate with 100-psig (688-kPa) minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water repellant-treated, ASTM C 533, Type 1, with 100 psig minimum compressive strength or ASTM C 552, Type II cellular glass, fiberglass blocks or calcium silicate with 100-psig (688-kPa) minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.5 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components (galvanized or stainless steel supports and stainless steel fasteners, rods, nuts, washers, attachments, etc.) to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb. All supports shall be hot-dipped galvanized construction with stainless steel rods, fasteners, etc. Curb mounted pipe stands shall be by Pate or Thybar.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes. All supports shall be hot-dipped galvanized construction with stainless steel rods, fasteners, etc.

2.7 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane. Condensate drain systems only.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

N. Insulated Piping:

1. Attach clamps and spacers to piping.
   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.

5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

O. Pipe hangers and supports shall be attached to the panel point at the top chord of bar joist or at a location approved by the Structural Engineer. Do not support all parallel piping from the same bar joist (pipe sizes 3-inches and larger) unless approved by the Structural Engineer.

P. The majority of the building is wood construction. Coordinate pipe supports with the requirements indicated on the structural drawings.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

D. Review proposed equipment supports with the structural engineer. Submit shop drawings of proposed supports and hanging methods for ERVs and AHUs.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings or inserts on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use painted or zinc-coated carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general interior service applications. Use galvanized or stainless steel pipe hangers and supports, trapeze pipe hangers, and framing systems and attachments for exterior service applications.

F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
2. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
3. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
4. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
5. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.

6. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
7. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction might occur.
8. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
9. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
10. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb (340 kg).
    b. Medium (MSS Type 32): 1500 lb (680 kg).
    c. Heavy (MSS Type 33): 3000 lb (1360 kg).

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
3. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
4. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
5. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
6. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners instead of building attachments where required in concrete construction.

R. Regardless of spacing, hangers shall be provided at all changes in direction, both vertical and horizontal, for all piping.

S. Where not practical to obtain ceiling anchorage, all piping near walls shall be supported by approved brackets securely anchored into the wall construction.

T. For piping located in and supported from the building structure, hanger spacing and rod sizes for steel and copper pipe shall not be less than the following for horizontal piping:

Nominal Pipe Size Inches	Maximum Span Feet		Minimum Rod Diameter inches of ASTM A36 Steel Threaded Rods
	Standard Steel Pipe	Copper Tube	
3/4 & 1	6	5	3/8

Nominal Pipe Size Inches	Maximum Span Feet		Minimum Rod Diameter inches of ASTM A36 Steel Threaded Rods
	Standard Steel Pipe	Copper Tube	
1 – 1/4	6	6	3/8
1-1/2	8	6	3/8
2	8	8	3/8
2-1/2	8	8	1/2
3	10	10	1/2
4	10	10	5/8
5	10	10	5/8
6	12	12	3/4
8	12	12	7/8
10	14	12	7/8
12	14	12	7/8

END OF SECTION

SECTION 23 05 48 - VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Freestanding and restrained spring isolators.
5. Housed spring mounts.
6. Elastomeric hangers.
7. Spring hangers.
8. Spring hangers with vertical-limit stops.
9. Pipe riser resilient supports.
10. Resilient pipe guides.
11. Freestanding and restrained air-mounting system.
12. Restrained vibration isolation roof-curb rails.
13. Seismic snubbers.
14. Restraining braces and cables.
15. Steel and inertia, vibration isolation equipment bases.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

1. Minimum 10 lb/sq. ft. (48.8 kg/sq. m) multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

C. Welding certificates.

D. Qualification Data: For engineer and testing agency.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 SUMMARY

A. Provide all labor and materials necessary to furnish and install vibration control systems on this project as herein specified and/or shown on the drawings.

B. Mount all mechanical equipment on suitable vibration isolators so as to prevent transmission of vibration into or through the building structure. Isolators shall be as manufactured by Mason Industries, Inc., Amber/Booth, Kenitics, or Peabody, and shall be selected by the isolator manufacturer for each item of equipment in accordance with requirements hereinafter specified.

C. The equipment manufacturer shall supply all pump and motor bases, fan and motor bases, cradles, pipe/duct hangers, spring and/or neoprene isolators, neoprene pads, flexible connectors, etc., as a coordinated package by a single manufacturer.

D. Select isolators for uniform static deflections according to distribution of weight; and for not less than the indicated isolation efficiency with the lowest rotational speed of equipment as the disturbing frequency.

E. Isolators and bases shall be stable during stopping and starting of equipment without transverse or eccentric movement of equipment, and shall be designed to resist horizontal forces of equipment which may operate unbalanced.

F. In general, select isolators on the basis of criteria as specified in the ASHRAE Applications Handbook, Latest Edition.

G. Vibration isolators shall be a delegated design based on the products and criteria provided. The design shall be based on the specific equipment and materials provided by the contractor(s)

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Indusries, or a comparable product by one of the following:

1. Amber/Booth Company, Inc.
2. Kinetics Noise Control.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant rubber, Mason Super W.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range, Mason Type No.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Restrained Mounts: All-directional mountings with seismic restraint.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

E. Spring Isolators – Mason Model SLF: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

F. Restrained Spring Isolators – Mason Type SLR: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

G. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.

1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.

2. Base: Factory drilled for bolting to structure.
3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch (6-mm) travel up or down before contacting a resilient collar.

H. Elastomeric Hangers Mason Type HD: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

I. Spring Hangers Mason Type 30N: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

J. Spring Hangers with Vertical-Limit Stop – Mason Type PC30N: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

K. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig (3.45 MPa) and for equal resistance in all directions.

L. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 THRUST RESTRAINTS

A. Adjustable spring thrust restraints, able to resist the thrust force with at least 25 percent unused capacity. The operating spring deflection shall be not less than 50 percent of the static deflection of the isolation supporting the machinery. The spring element shall be contained within a steel frame and designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4" movement at start and stop. The assembly shall be furnished with one rod and angle bracket for attachment to both the equipment and ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrically on either side of the unit. Horizontal thrust restraints shall be Type WB.

2.3 FLEXIBLE CONNECTORS FOR PIPING

A. General: Straight flexible connectors rated for temperatures, pressures, and fluids to be conveyed. Provide flexible connectors with the strength 4 times operating pressure at highest system operating temperature. Provide elbow flexible connectors with a permanently set angle.

B. Metal Flexible Connectors: Fabricated of grade E phosphor bronze, monel or corrugated stainless steel tube covered with comparable bronze or stainless steel braid restraining and pressure cover. Sizes 3" and larger shall be flanged. Sizes 2-1/2" and smaller shall have male nipples. Lengths shall be as indicated:

NOMINAL DIAMETER (INCHES)	LENGTH (INCHES)
1/2”	9”
3/4”	10”
1”	11”
1-1/4”	12”
1-1/2”	12”
2”	12”
2-1/2”	12”
3”	18”
4”	18”
5”	18”
6”	18”
8”	18”
10”	18”
12”	18”
14”	18”
16”	18”

C. Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible. Hoses shall be Type BSS.

2.4 VIBRATION ISOLATION EQUIPMENT BASES

A. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries or a comparable product by one of the following:

1. Amber/Booth Company, Inc.
2. Kinetics Noise Control.

B. Steel Base: Factory-fabricated, welded, structural-steel bases and rails. Mason Type WF and Mason Type ICS.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

   a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Inertia Base- Mason Industries BMK/KSL bases with modular corners: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
   a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel modular corner brackets on frame for isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.5 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanized metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic- and wind-control devices to indicate capacity range.

2.6 ACOUSTICAL FLOOR, CEILING AND WALL SEAL:

A. Provide acoustical floor, ceiling, and wall seal where piping passes through mechanical equipment room/fan and air handling unit room walls, floors, or ceilings, and any noise-sensitive areas. The vibration isolator manufacturer shall provide a split seal consisting of two bolted pipe halves with 3/4” or thicker neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of 1" past either face of the wall. Where temperatures exceed 240ºF, 10# density fiberglass shall be used in lieu of the sponge. Seals shall be Type SAWS.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic- and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

C. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
3. Brace a change of direction longer than 12 feet (3.7 m).

D. Install cables so they do not bend across edges of adjacent equipment or building structure.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

I. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. Test and adjust air-mounting system controls and safeties.
10. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust air-spring leveling mechanism.

D. Adjust active height of spring isolators.

E. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Division 01 Section "Demonstration And Training."

3.8 GENERAL PROVISIONS

A. Install vibration-and-noise isolation materials and equipment as indicated and in accordance with machinery manufacturer's instructions.

B. Where neoprene elements of vibration isolator may be subjected to high pipe temperatures above 160 deg F, provide metal heat shields or thermal isolators.

C. A minimum of 4" thick concrete housekeeping pads shall be provided under all floor mounted equipment. A minimum of 6" thick concrete housekeeping pads shall be provided under all air handling units, chillers, boilers and where indicated. Rest sub-bases on structural floor and reinforce with steel rods interconnected with floor reinforcing bars by tie bars hooked at both ends. Provide at least one (1) inch clearance between sub-bases and inertia bases, steel bases, and steel saddles with machinery in operation.

D. All vibration isolators exposed to weather shall be hot dipped galvanized with springs coated with neoprene.

E. Concrete inertia bases shall be a minimum of two (2) times the weight supported. Clearance between the underside of the inertia base and the housekeeping pad below shall not be less than 1 inch. Concrete shall be 3000 psi. Install inertia bases in accordance with the recommendations of the machinery manufacturer and the inertia base manufacturer.

F. Anchor Bolts and Grout: Secure machinery to foundations and inertia bases with anchor bolts. Grout equipment with baseplates, the full area under baseplates with premixed non-shrinking grout. After grout has set, remove wedges, shims, and jack bolts and fill spaces with grout.

G. Common Machinery Foundations: Mount electrical motors on the same foundations as driven machinery. Support piping connections, strainers, valves, and risers on the same foundation as the pumps.

H. Vertical Stops: For machinery affected by wind pressure or having an operational weight different from installed weight, provide resilient vertical limit stops which prevent spring extension when weight is removed. Provide vertical stops for machinery containing liquid, such as water chillers, evaporative coolers, boilers, and cooling towers. Spring isolated or protected spring isolated machinery must rock and move freely within limits of stops or seismic restraint devices.

I. Thrust Restraints: Where required, provide pairs of thrust restraints, symmetrically installed on both sides of the steady state line of thrust.

J. Machinery: Provide vibration isolators, flexible connectors and seismic snubbers in accordance with manufacturer's recommendations. Machinery with spring isolators or protected spring isolators shall rock or move freely within limits of stops or seismic snubber restraints.

K. Stability: Isolators shall be stable during starting and stopping of machinery without traverse and eccentric movement of machinery that would damage or adversely affect the machinery or attachments.

L. Lateral Motion: The installed vibration isolation systems for each piece of floor or ceiling mounted machinery shall have a maximum lateral motion under machinery start up and shut down conditions of not more than 1/4-inch. Restrain motions in excess by approved spring mountings.

M. Unbalanced Machinery: Provide foundation suspension systems specifically designed to resist horizontal forces for machinery with large unbalanced horizontal forces. Vibration isolator systems shall conform to the machinery manufacturer's recommendations.

N. Non-Rotating Machinery: Mount non-rotating machinery in systems which include rotating or vibrating machinery on isolators having the same deflection as the hangers and supports for the pipe connected to.

O. Unitized Machinery Assemblies: Unitized assemblies such as chillers with evaporator and condenser, and top mounted centrifugal compressor or unitized absorption refrigeration machines, structurally designed with end supports, may be mounted on steel rails and springs in lieu of steel bases and springs. Where

the slab or deck is less than 4 inches thick, provide spring isolation units with the deflection double that of the vibration isolation schedule, up to a maximum static deflection of 5 inches.

P. Roof and Upper Floor Mounted Machinery: On the roof or upper floors, mount machinery on isolators with vertical stops. Rest isolators on beams or structures designed and installed in accordance with the SMACNA ASMM Plate 61.

Q. Vibration isolation ceiling hangers shall be installed so that the hanger rods do not touch the sides of the isolator housing, thereby seriously degrading the vibration isolation performance. Vibration isolation ceiling hangers shall be located so that the hanger housing may rotate 360º without touching any object.

R. Electrical Connections: Provide flexible conduit or multiple conductor cable connections for machinery with sufficient extra length to permit 2 inch minimum displacement in any direction without damage.

S. Systems Not to be Vibration Isolated: Do not provide vibration isolation for electrical raceways and conduits or for fire protection, storm, sanitary, and domestic water piping systems which do not include pumps or other vibrating, rotating, or pulsating equipment including control and pressure reducing valves.

3.9 PIPE ISOLATION:

A. Horizontal Pipe Isolation

1. Precompressed Suspension Spring Isolators: The first three pipe hangers in the main lines near the mechanical equipment provide precompressed suspension spring isolators. Floor supported piping shall rest on trained spring isolators. All precompressed suspension spring isolators hangers or the first three trained spring isolators mounts as noted above, will have the same static deflection as specified for the mountings under the connected equipment. If piping is connected to equipment located in basements and hangs from ceiling under occupied spaces, the first three hangers shall have 0.75" deflection for pipe sizes up to and including 3", 1.5" deflection for pipe sizes up to and including 6" and 2.5" deflection thereafter. All other hangers and mounts will have a minimum steel spring deflection of 0.75". Hangers shall be located as close to the overhead supports as practical.
2. Combination Spring and Neoprene Suspension Hanger: For horizontal runs in Mechanical Equipment Rooms (including Air Handling Unit Rooms) other than those hereinbefore specified, provide suspension spring hangers (combination spring and neoprene) with .75" minimum steel spring deflection.

B. Floor-Supported Piping:

1. Floor supports for piping in equipment rooms and adjacent to isolated equipment shall use vibration isolators as described hereinbefore and selected to the guidelines of hangers.
2. The first three adjacent floor supports shall be the restrained spring type with a blocking feature that prevents load transfer to equipment flanges as the piping is filled and drained.
3. Where piping is subject to larger thermal movement a slide plate shall be installed on the top of the isolator. Slide plate shall be teflon, graphite or steel.
4. Provide a thermal barrier where neoprene products are installed directly beneath steam or hot water lines.

C. Pipe Risers: Provide pipe riser supports with bearing plates and two layers of 1/4" thick ribbed or waffled neoprene pad loaded to not more than 50 psi. Separate isolation pads with 1/4" steel plate. Weld pipe riser clamps at anchor points to the pipe and to pairs of vertical acoustical pipe anchor mountings which shall be rigidly fastened to the steel framing.

D. Supports at Base of Pipe Risers: Piping isolation supports at the base of risers shall be two layers of 1/2" thick heavy-duty neoprene pad separated by 1/4" thick steel plate. Use bearing plates sized to provide a pad loading of not more than 500 psi. Weld the stanchion between the pipe and isolation support to the pipe and weld or bolt to the isolation support. Bolt isolation support to the floor slab with resilient sleeves and washers. Where supplementary steel is required to support piping, provide a maximum deflection of 0.08 inches at the mid-span of this steel under the load. Rigidly support piping from the supplementary steel with the supplementary steel isolated from the building structure with isolators.

E. Pipe Anchors: Attach each end of the pipe anchor to an omni-directional pipe isolator which in turn shall be rigidly fastened to the steel framing or structural concrete. Provide a telescoping pipe isolator of two sizes of steel tubing separated by a minimum 1/2" thick pad of heavy-duty neoprene or heavy-duty neoprene and canvas. Provide vertical restraints by similar material to prevent vertical travel in either direction. The load on the isolation material shall not exceed 500 psi.

3.10 EQUIPMENT ROOM SOUND ISOLATION:

A. Do not allow direct contact between pipes or ducts and walls, floor slabs, roofs, ceilings or partitions of equipment rooms.

B. Pipe Penetrations: All piping passing through Mechanical Equipment Room and Fan/Air Handling Unit Room walls, floors and ceilings shall be protected against sound leakage by means of an acoustical wall seal as described hereinbefore.

C. Duct Penetrations: Provide with sound insulation equal to the sound attenuation value of the wall, floor, or ceiling penetrated.

3.11 FLEXIBLE PIPE CONNECTORS:

A. Provide flexible connectors in accordance with Manufacturers instructions where piping systems serving vibration isolated equipment and as shown on the drawings. Flexible connectors shall be installed near the connection to the equipment. Where liquid pulsation dampening is required, flexible connectors with spherical configuration may be used. Provide restraints for pipe connectors at pumps to prevent connector failure upon pump start-up. Flexible pipe connectors shall be twin-sphere type.

3.12 ISOLATION FOR SPECIFIC EQUIPMENT:

A. The vibration isolator manufacture shall provide isolators for all pieces of equipment provided for the job. Isolator shall be selected by the isolator manufacturer on the basis of criteria as specified in the latest edition of ASHRAE Applications Handbook, unless a more stringent requirement is indicated on the drawings. The vibration isolators shall be confirmed by the manufacturers recommendations.

B. Pumps:

1. All base-mounted pumps shall be mounted on concrete inertia blocks with modular corners for isolators supported on stable steel springs in series with ribbed neoprene pads selected for not less than 1.00 inch static deflection under full operating load.
2. Floor support of the initial pipe elbows at the pump discharge and suction diffuser at the pump intake shall be made from the isolated inertia base, not from the equipment room floor.
3. Provide flexible pipe connections at pump suction and discharge twin sphere type, Mason Safeflex SFDEJ.

C. Cabinet/In-Line Fan(s): Suspended – Provide combination spring and neoprene type isolator with a minimum deflection of 1"; Mason Industries Type 30N, or approved equal.

D. Cabinet Unit Heaters (Ceiling Hung Type): Provide combination spring and neoprene isolator, Mason Type W30, at 1.00” minimum deflection.

E. AHUs and ERVs Units supported from structure shall be provided with spring and Neoprene type isolator with 1. 0” minimum depletion, Mason type 30N.

F. Chillers: Locate on Neoprene mounts, Mason BR at 0.25” static deflection and provide Twin Sphere flexible pipe connectors, Mason Safeflex SFDEJ. Provide refrigerant flexible connectors suitable for the pressure and temperature requirements for the application with enough slack to form 8” deep U-shaped bend. Coordinate with the equipment manufacture.

G. Flexible connectors (3” minimum) shall be provided for all AHU and fan connections.

H. Rooftop Condensing Unit: Provide neoprene mounts at 0.25" static deflection, Mason BR. Provide refrigerant flexible connectors suitable for the pressure and temperature requirements for the application with enough slack to form 8" deep U-shaped bend. Coordinate with the equipment manufacture.

I. General

1. All equipment driven by motors 3 hp or larger shall be installed on combination metal spring and neoprene isolators sized to provide a static deflection of 1" or 2" based of rotational speed of the fan, location of the equipment and the supporting structure. Mounts shall be Mason SLR and Hangers shall be Mason 30N.
2. All equipment driven by motors smaller than 3 hp shall be installed with elastomeric mounts that provide 0.3" static deflection; Mounts Mason ND and Hangers Mason HD.
3. Duct and pipe penetrations: Provide duct and pipe sleeves with a minimum of ½" gap to be filled with backer rod and resilient type sealant.
4. Refrigerant piping: For refrigerant piping located above occupied spaces wrap piping with Limp-Lagging, quilted fiberglass decoupling layer with mass-loaded vinyl outer layer (minimum 1 PSF): Sound Seal B-10 LAG/QFA-3.
5. Suspended piping within 50 ft of vibration-isolated equipment and pressure regulating valves shall be provided with metal spring and neoprene hanger vibration isolators, Mason 30N. The first 3 hangers shall have the same static deflection of the equipment (2.0" or less static deflection) and the remaining piping shall be 0.75" static deflection.
6. Isolate all suspended piping with a diameter of 2" or larger below and adjacent to noise sensitive areas (i.e. offices) with combination spring and neoprene hangers a minimum of 0.75" static deflection. This includes piping located in mechanical equipment rooms located under office areas.
7. Isolate floor supported piping in equipment rooms etc. with restrained combination metal spring and neoprene isolators in close proximity of the equipment; Mason SLR. Provide thrust rods or thrust restraints where piping is subject to thermal movement; Mason WBI/WBD
8. For all other pipe support locations provide vibration isolation as follows:
    a. For strut locations provide resilient clamps such as Hydro-Craft Hydro Strut
    b. Avoid plastic type clamps (Hydra-Zorb, Cush-A-Clamp)
    c. Provide Holdtight Silencer Products and LSP Acoustics at hanger clamps.
    d. Provide Calcium Silicate load bearing thermal inserts at clamps and hangers.
    e. No direct contact between pipe and pipe hanger or clamp.

J. Emergency Generator: Provide Restrained combination metal spring and neoprene mounts with 2" static deflection; Mason SLR. Coordinate with the Electrical Contractor. Provide air intake duct silencers selected to reduce intake air sound levels to 57 dBA at the inlet openings; Price RL48/XF. Provide radiator fan discharge duct silencer to reduce the discharge sound level to 68 dBA; Price RL36/YE. Duct silencers shall be custom fabricated (by VAW Systems Ltd.) where required based on these requirements and associated ductwork. Maximum pressure drop for the duct system inlet attenuator shall be 0.10" SP and for the radiator discharge duct system maximum pressure drop shall be 0.15" SP. Coordinate duct silencers with the generator manufacturer and Electrical Contractor. Note: The ceiling of the generator room shall be hung on spring isolators. Refer to architectural drawings for additional information. Coordinate all hanger and other penetrations through this ceiling system with the installing contractor.

END OF SECTION

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, snap-on semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive (4” and less). For larger pipe (sizes 6” and greater) markers shall be strapped around using nylon ties.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME (ANSI) A13.1 for piping; minimum letter height of 1-1/4 inches (32 mm) for ducts; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Aluminum.
2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel in colors according to ASME (ANSI) A13.1 unless otherwise indicated.

B. Duct Identification Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) black-filled letters for piping system abbreviation and 1/2-inch (13-mm) numbers; 2-inch diameter.

1. Tag Material: Brass, 19-gauge, minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass jack chain and/or brass S Hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 4 by 7 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09.

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME (ANSI) A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 25 feet along each run. Reduce intervals to 15 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
8. Where pipes are adjacent to each other, markings shall be neatly lined up. All markings shall be located in such a manner to be easily legible from the floor.
9. For piping less than 3/4-inch, provide permanently legible tag as specified hereinbefore for valve identification.
10. For buried piping, provide 2-inch minimum width plastic identification/detection tape with metallic core. Install 4-6-inches below-grade.

D. Pipe Label Color Schedule:

1. Chilled-Water Piping:

   a. Background Color: Blue.
   b. Letter Color: White.

2. Heating Water Piping:

   a. Background Color: Orange.
   b. Letter Color: Black.

3. Refrigerant Piping:

   a. Background Color: Black.
   b. Letter Color: White.

3.4 DUCT LABEL IDENTIFICATION

A. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, shall be provided.

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 25 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

   a. Chilled Water: 2 inches (50 mm); round.
   b. Refrigerant: 2 inches (50 mm), round.
   c. Hot Water: 2 inches (50 mm), round.

2. Valve-Tag Color:

   a. Chilled Water: Natural.
   b. Refrigerant: Natural.
   c. Hot Water: Natural.

3. Letter Color:

   a. Chilled Water: Black.
   b. Refrigerant: Black.
   c. Hot Water: Black.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.7 SERVICE AND MAINTENANCE ITEMS

A. Provide a color coded acrylic ceiling identification markers for valves, dampers, equipment, and items requiring access for service and maintenance.

B. Provide ceiling grid equipment labels for equipment concealed above ceilings in addition to labels on equipment.

END OF SECTION

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:
   a. Constant-volume air systems.
   b. Variable-air-volume systems.
2. Balancing Hydronic Piping Systems:
   a. Constant-flow hydronic systems.
   b. Variable-flow hydronic systems.
   c. Primary –Secondary hydronic systems.
   d. Domestic hot water system.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. Certified TAB reports.

E. Sample report forms.

F. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC as a TAB technician.

B. TAB Conference: Meet with Architect, Owner, Commissioning Agent and Engineer on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide 14 days' advance notice of scheduled meeting time and location.

1. Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Coordination and cooperation of trades and subcontractors.
d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB contractor's forms approved by Architect, Owner, Construction Manager, Commissioning Authority.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations. After occupancy no activities are permitted during normal school operating hours.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

C. The project will have all systems fully commissioned by an independent Commissioning Company.

1.7 COORDINATION

A. Notice: Provide fourteen days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

A. All testing and balancing shall be performed by an independent test and balance agency that specializes in and whose business is limited to the testing and balancing of mechanical systems. The agency must have membership in the “Associated Air Balance Council” and have an Engineer certified by the National Examining Board. All final reports shall be signed and officially stamped by the certified test and balance engineer.

B. Subject to compliance with requirements, engage one of the following available TAB contractors that may be engaged include, but are not limited to, the following:

1. Baltimore Air Balance Company.
2. Baumgartner, Inc.
3. American Testing, Inc.
4. Chesapeake Testing and Balancing Engineers, Inc.
5. Weisman, Inc.
6. Butler Balancing Company, Inc.
7. Flood and Sterling, Inc.
8. WAE Balancing.

3.2 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

I. Examine terminal units, such as space fan coil units, and verify that they are accessible and their controls are connected and functioning.

J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

N. Examine operating safety interlocks and controls on HVAC equipment.

O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 REQUIREMENTS

A. Test and balance all heating, ventilating, and air conditioning systems. The work shall include, but not be limited to, the following:

B. Witness all leak tests for ductwork and air distribution systems.

C. Balance and adjust all air distribution systems (including air terminal devices) to within 5% of design air quantities, including maximum and minimum heating, cooling, and set-points of air handling units.

D. Adjust all fans to required speeds for design air flow, including changing sheaves.

E. Test the capacity and performance of all equipment and adjust to design conditions.

F. Operate and test all systems under all sequences of operation and adjust equipment and controls for efficient and stable operation.

G. Test and balance all systems under adequate load conditions. If, in the opinion of the Engineer, there is insufficient load to properly test and balance the systems, perform sufficient preliminary balancing and adjustment to permit operation of the systems until such time as final testing and balancing can be done.

H. Retest or rebalance the systems as required during the guarantee period.

I. Provide water and air test and balance for all air handling systems (AHU's, DOAS units, BCU's). Retest and rebalance all equipment at the completion of the project.

3.4 COORDINATION BY THE MECHANICAL CONTRACTOR

A. Coordinate the testing and balancing work with the work of other trades.

B. Furnish complete and up-to-date contract documents, shop drawings, installation and coordination drawings, submittal data, and other information to the testing and balancing agency so that the work is performed using all required system and equipment data.

C. Plan and schedule testing and balancing at required times during construction. Review all plans, schedules, and procedures with the Engineer before proceeding.

D. Prepare all systems for testing and balancing. Provide clean filters in all air systems and clean strainers and traps in the piping systems. Provide final flushing of piping systems if required.

E. Make all necessary adjustments and repairs to the work, correcting any malfunctions or deficiencies which are disclosed by testing and balancing.

3.5 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.6 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.7 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.8 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

   a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

   a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
   b. Measure static pressure directly at the fan outlet or through the flexible connection.
   c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
   d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

   a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps and heat-recovery equipment, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from Architect, Owner, Construction Manager, Commissioning Authority for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

   a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.9 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure for the critical terminal (heat pump) unit.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal unit at maximum airflow and adjust static pressure sensor to deliver the designed maximum airflow. When total airflow is correct, balance the air outlets downstream from terminal (heat pump) units the same as described for constant-volume air systems.
5. Set terminal units airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

   a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

   a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record final fan-performance data.

3.10 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.
9. For variable flow systems develop a plan to simulate diversity (i.e. heating system coils are sized based on heat wheel failure).

3.11 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYTEMS

A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gauge heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Architect, Owner, Construction Manager and Commissioning Authority and comply with requirements in Division 23 Section "Hydronic Pumps."
2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge vale until indicated water flow is achieved. Monitor motor performance during procedures and do not operate motors in overload conditions.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 10 percent of design.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

D. Set calibrated balancing valves, if installed, at calculated presettings.

E. Measure flow at all stations and adjust, where necessary, to obtain first balance. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating devices.

F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures, including outdoor-air temperature.

I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

J. Check settings and operation of each safety valve. Record settings.

3.12 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange heat pump units and proceed as specified above for hydronic systems.

3.13 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary-circuit flow first and then balance the secondary circuits.

3.14 PROCEDURES FOR WATER-TO-WATER HEAT EXCHANGERS

A. Measure water flow through all circuits.

B. Adjust water flow to within specified tolerances.

C. Measure inlet and outlet water temperatures.

D. Measure inlet and outlet pressure.

E. Check settings and operation of safety and relief valves. Record settings.

3.15 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers or ECMS: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.16 PROCEDURES FOR CHILLERS

A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:

1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
2. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
3. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
4. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
5. Capacity: Calculate in tons of cooling.
6. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.17 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.18 BOILERS

A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

3.19 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.20 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 5 percent.
2. Air Outlets and Inlets: Plus or minus 5 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Geothermal-Water Flow Rate: Plus or minus 10 percent.

3.21 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.22 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.

g. Settings for supply-air, static-pressure controller.
h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches (mm), and bore.
i. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
j. Number, make, and size of belts.
k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches (mm), and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

3. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm (L/s).
b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Filter static-pressure differential in inches wg (Pa).
f. Preheat-coil static-pressure differential in inches wg (Pa).
g. Cooling-coil static-pressure differential in inches wg (Pa).
h. Heating-coil static-pressure differential in inches wg (Pa).
i. Outdoor airflow in cfm (L/s).
j. Return airflow in cfm (L/s).
k. Outdoor-air damper position.
l. Return-air damper position.
m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch (mm) o.c.

f. Make and model number.
g. Face area in sq. ft. (sq. m).
h. Tube size in NPS (DN).
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm (L/s).
b. Average face velocity in fpm (m/s).
c. Air pressure drop in inches wg (Pa).
d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
h. Water flow rate in gpm (L/s).
i. Water pressure differential in feet of head or psig (kPa).
j. Entering-water temperature in deg F (deg C).
k. Leaving-water temperature in deg F (deg C).
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig (kPa).
n. Refrigerant suction temperature in deg F (deg C).
o. Inlet steam pressure in psig (kPa).

G. Gas-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btu/h (kW).
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches (mm), and bore.
n. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

2. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm (L/s).
b. Entering-air temperature in deg F (deg C).
c. Leaving-air temperature in deg F (deg C).
d. Air temperature differential in deg F (deg C).
e. Entering-air static pressure in inches wg (Pa).
f. Leaving-air static pressure in inches wg (Pa).
g. Air static-pressure differential in inches wg (Pa).
h. Low-fire fuel input in Btu/h (kW).
i. High-fire fuel input in Btu/h (kW).
j. Manifold pressure in psig (kPa).
k. High-temperature-limit setting in deg F (deg C).
l. Operating set point in Btu/h (kW).
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h (kW).

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

    a. System identification.
    b. Location.
    c. Make and type.
    d. Model number and size.
    e. Manufacturer's serial number.
    f. Arrangement and class.
    g. Sheave make, size in inches (mm), and bore.
    h. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

2. Motor Data:

    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches (mm), and bore.
    f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
    g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

    a. Total airflow rate in cfm (L/s).
    b. Total system static pressure in inches wg (Pa).
    c. Fan rpm.
    d. Discharge static pressure in inches wg (Pa).
    e. Suction static pressure in inches wg (Pa).

I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

    a. System and air-handling-unit number.
    b. Location and zone.
    c. Traverse air temperature in deg F (deg C).
    d. Duct static pressure in inches wg (Pa).
    e. Duct size in inches (mm).
    f. Duct area in sq. ft. (sq. m).
    g. Indicated air flow rate in cfm (L/s).
    h. Indicated velocity in fpm (m/s).
    i. Actual air flow rate in cfm (L/s).
    j. Actual average velocity in fpm (m/s).
    k. Barometric pressure in psig (Pa).

J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

    a. System and air-handling-unit identification.
    b. Location and zone.
    c. Room or riser served.
    d. Coil make and size.
    e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

    a. Air flow rate in cfm (L/s).
    b. Entering-water temperature in deg F (deg C).
    c. Leaving-water temperature in deg F (deg C).
    d. Water pressure drop in feet of head or psig (kPa).
    e. Entering-air temperature in deg F (deg C).
    f. Leaving-air temperature in deg F (deg C).

K. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model number and serial number.
f. Water flow rate in gpm (L/s).
g. Water pressure differential in feet of head or psig (kPa).
h. Required net positive suction head in feet of head or psig (kPa).
i. Pump rpm.
j. Impeller diameter in inches (mm).
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig (kPa).
b. Pump shutoff pressure in feet of head or psig (kPa).
c. Actual impeller size in inches (mm).
d. Full-open flow rate in gpm (L/s).
e. Full-open pressure in feet of head or psig (kPa).
f. Final discharge pressure in feet of head or psig (kPa).
g. Final suction pressure in feet of head or psig (kPa).
h. Final total pressure in feet of head or psig (kPa).
i. Final water flow rate in gpm (L/s).
j. Voltage at each connection.
k. Amperage for each phase.

L. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.23 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:

a. Measure airflow of at least 5 percent of air outlets.
b. Measure water flow of at least 5 percent of terminals.
c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
d. Verify that balancing devices are marked with final balance position.
e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect, Owner, Engineer, Commissioning Authority.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect, Owner, Engineer, Commissioning Authority.
3. Architect, Owner, Engineer, Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.24 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 07 00 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Insulation Materials:
   a. Flexible elastomeric.
   b. Mineral fiber.
2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Lagging adhesives.
7. Sealants.
8. Factory-applied jackets.
9. Field-applied fabric-reinforcing mesh.
10. Field-applied cloths.
11. Field-applied jackets.
12. Tapes.
13. Securements.
14. Corner angles.

B. Related Sections:

1. Division 22 Section "Plumbing Insulation."
2. Division 23 Section "Metal Ducts" for duct liners.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.

1. Sample Sizes:

a. Preformed Pipe Insulation Materials: 12 inches (300 mm) long by NPS 2 (DN 50).
b. Sheet Form Insulation Materials: 12 inches (300 mm) square.
c. Jacket Materials for Pipe: 12 inches (300 mm) long by NPS 2 (DN 50).
d. Sheet Jacket Materials: 12 inches (300 mm) square.
e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

D. Qualification Data: For qualified Installer.

E. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

F. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type II with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Duct Wrap.
d. Owens Corning; All-Service Duct Wrap.

H. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; HTB 23 Spin-Glas.
b. Owens Corning; High Temperature Flexible Batt Insulations.

I. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; Commercial Board.
b. Fibrex Insulations Inc.; FBX.
c. Johns Manville; 800 Series Spin-Glas.
d. Knauf Insulation; Insulation Board.
e. Manson Insulation Inc.; AK Board.
f. Owens Corning; Fiberglas 700 Series.

J. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Fibrex Insulations Inc.; FBX.
b. Johns Manville; 1000 Series Spin-Glas.
c. Owens Corning; High Temperature Industrial Board Insulations.
d. Rock Wool Manufacturing Company; Delta Board.
e. Roxul Inc.; Roxul RW.
f. Thermafiber; Thermafiber Industrial Felt.

K. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000 Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied -SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
3. Type II, 1200 deg F (649 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied -SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

L. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; CrimpWrap.
b. Johns Manville; MicroFlex.
c. Knauf Insulation; Pipe and Tank Insulation.
d. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F (927 deg C). Comply with ASTM C 656, Type II, Grade 6. tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.

1. Products: Subject to compliance with requirements, provide the following:

a. Johns Manville; Super Firetemp M.

B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. CertainTeed Corp.; FlameChek.
   b. Johns Manville; Firetemp Wrap.
   c. Nelson Firestop Products; Nelson FSB Flameshield Blanket.
   d. Thermal Ceramics; FireMaster Duct Wrap.
   e. 3M; Fire Barrier Wrap Products.
   f. Unifrax Corporation; FyreWrap.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Aeroflex USA Inc.; Aeroseal.
   b. Armacell LCC; 520 Adhesive.
   c. Foster Products Corporation, H. B. Fuller Company; 85-75.
   d. RBX Corporation; Rubatex Contact Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Products, Division of ITW; CP-82.
   b. Foster Products Corporation, H. B. Fuller Company; 85-20.
   c. ITW TACC, Division of Illinois Tool Works; S-90/80.
   d. Marathon Industries, Inc.; 225.
   e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Products, Division of ITW; CP-82.
   b. Foster Products Corporation, H. B. Fuller Company; 85-20.
   c. ITW TACC, Division of Illinois Tool Works; S-90/80.
   d. Marathon Industries, Inc.; 225.
   e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Dow Chemical Company (The); 739, Dow Silicone.
   b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
   c. P.I.C. Plastics, Inc.; Welding Adhesive.

d. Speedline Corporation; Speedline Vinyl Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.
f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-30.
b. Foster Products Corporation, H. B. Fuller Company; 30-35.
c. ITW TACC, Division of Illinois Tool Works; CB-25.
d. Marathon Industries, Inc.; 501.
e. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; Encacel.
b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
c. Marathon Industries, Inc.; 570.
d. Mon-Eco Industries, Inc.; 55-70.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:
    a. Childers Products, Division of ITW; CP-10.
    b. Foster Products Corporation, H. B. Fuller Company; 35-00.
    c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
    d. Marathon Industries, Inc.; 550.
    e. Mon-Eco Industries, Inc.; 55-50.
    f. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 3 perms (2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F (Minus 29 to plus 93 deg C).
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, provide one of the following:
    a. Childers Products, Division of ITW; CP-52.
    b. Foster Products Corporation, H. B. Fuller Company; 81-42.
    c. Marathon Industries, Inc.; 130.
    d. Mon-Eco Industries, Inc.; 11-30.
    e. Vimasco Corporation; 136.
3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
4. Service Temperature Range: Minus 50 to plus 180 deg F (Minus 46 to plus 82 deg C).
5. Color: White.

2.6 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
    a. Childers Products, Division of ITW; CP-76-8.
    b. Foster Products Corporation, H. B. Fuller Company; 95-44.
    c. Marathon Industries, Inc.; 405.
    d. Mon-Eco Industries, Inc.; 44-05.
    e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants, Vinyl, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
    a. Childers Products, Division of ITW; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, or paper-free (Owens Corning Evolution) fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the work, but are not limited to, the following::

a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.9 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 20 mil thickness; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto PVC Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

5. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; Metal Jacketing Systems.

b. PABCO Metals Corporation; Surefit.
c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.

a. Factory cut and rolled to size.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
e. Factory-Fabricated Fitting Covers:
1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.10 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
b. Compac Corp.; 110 and 111.
c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
b. Compac Corp.; 130.
c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
d. Venture Tape; 1506 CW NS.

2. Width: 2 inches (50 mm).
3. Thickness: 6 mils (0.15 mm).
4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
b. Compac Corp.; 120.
c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
d. Venture Tape; 3520 CW.

2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.11 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products; Bands.
b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316; 0.015 inch (0.38 mm) thick, 3/4 inch (19 mm) wide with wing or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm), wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Stainless steel- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

a. Products: Subject to compliance with requirements, provide one of the following:
1) AGM Industries, Inc.; CWP-1.
2) GEMCO; Cupped Head Weld Pin.
3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.

2. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the following:
1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
2) GEMCO; Perforated Base.
3) Midwest Fasteners, Inc.; Spindle.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
c. Spindle: Zinc-coated, low carbon steel, aluminum or stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

3. Insulation-Retaining Washers: Self-locking washers formed from 0.015-inch- thick, galvanized-steel or stainless steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Products: Subject to compliance with requirements, provide one of the following:
1) AGM Industries, Inc.; RC-150.
2) GEMCO; R-150.
3) Midwest Fasteners, Inc.; WA-150.
4) Nelson Stud Welding; Speed Clips.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy or 0.062-inch (1.6 mm) soft annealed stainless steel..

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C & F Wire.
b. Childers Products.
c. PABCO Metals Corporation.
d. RPR Products, Inc.

2.12 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.

B. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

Q. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance such as vessel covers, fasteners, flanges, frames and accessories.

R. Provide insulation inserts at pipe hangers. Refer to specification section 230529 “Hangers and Supports for HVAC Piping and Equipment” for requirements.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).

1. Comply with requirements in Division 07 Section "Penetration Firestopping"irestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

   a. Do not weld anchor pins to ASME-labeled pressure vessels.
   b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
   c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.
   d. Do not overcompress insulation during installation.
   e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
   f. Impale insulation over anchor pins and attach speed washers.
   g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.

7. Stagger joints between insulation layers at least 3 inches (75 mm).
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. For chilled water pumps fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch (150-mm) centers, starting at corners. Install 3/8-inch- (10-mm-) diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from aluminum or stainless steel, at least 0.040 inch (1.0 mm) thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.6 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or reusable valve wraps. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions.

Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
10. Heating hot water coil piping trim to terminal units (fan coil units, VAV units) and duct mounted coils does not need to be insulated if located a minimum of three (3) feet from the coil when located in air conditioning ductwork.
11. Insulate all heating coils and all connecting piping located within 3 feet of coil when located in air conditioning ductwork or air handling unit.
12. All valve stems shall be sealed with caulking.
13. Provide removable/flexible insulation covers with draw string ends and Velcro fastener for chilled water control valves (i.e., air handling units) and for heating water valves connected to coils located within 36” of coils in air conditioning air streams. Covers shall be as manufactured by NoSweat Reusable Valve Wraps or equal.
14. Provide 4” thick high temperature (1200 degrees F) Calcium Silicate type or mineral wool (John Manville Minwool-1200 pipe) pipe insulation for the emergency generator exhaust pipe including muffler to termination. Provide canvas jacket where located inside of building and aluminum jacket where located exterior of building.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.7 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install reusable valve wrap covers.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Impale insulation over pins and attach speed washers.
f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-(150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not overcompress insulation during installation.
e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-

shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.10 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

3.11 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

    a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.13 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return/relief.
4. Indoor, exposed return/relief.
5. Indoor, relief / exhaust downstream from heat recovery units/devices.
6. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
7. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
8. Outdoor, concealed supply and return.
9. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1, unless otherwise indicated.
3. Factory-insulated flexible ducts.

4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.
8. Exposed return air ductwork located in a conditioned space.

3.14 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 2 inches (38 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

B. Concealed, round and flat-oval, return-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 2 inches (38 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

C. Concealed, round and flat-oval, outdoor-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 2 inches (38 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

D. Concealed, round and flat-oval, exhaust-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 2 inches (38 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

E. Concealed, rectangular, supply-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 2 inches (38 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

F. Concealed, rectangular, return/relief-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 2 inches (38 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

G. Concealed, rectangular, outdoor-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 2 inches (38 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

H. Concealed, rectangular, exhaust-air duct insulation from heat recovery units and all exhaust air duct insulation between isolation damper and penetration of building exterior shall be the following:
   1. Mineral-Fiber Blanket: 2 inches (38 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

I. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

J. Concealed, supply-air plenum insulation shall be the following:
   1. Mineral-Fiber Blanket: 2 inches (38 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

K. Concealed, return/relief-air plenum insulation shall be the following:
   1. Mineral-Fiber Blanket: 2 inches (38 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

L. Concealed, outdoor-air plenum insulation shall be the following:

   1. Mineral-Fiber Blanket: 2 inches (38 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

M. Concealed, exhaust-air plenum insulation shall be the following:

   1. Mineral-Fiber Blanket: 2 inches (38 mm) thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

N. Exposed, round and flat-oval, supply-air duct insulation shall be the following:

   1. Exposed ductwork in occupied spaces does not require external insulation. Exposed ductwork shall be double wall pre-insulated.

O. Exposed, round and flat-oval, return-air duct insulation shall be the following:

1. Exposed ductwork in occupied spaces does not require external insulation. Exposed ductwork shall be double wall pre-insulated.

P. Exposed, round and flat-oval, outdoor-air duct insulation shall be the following:

1. Exposed ductwork in occupied spaces does not require external insulation. Where ductwork is double wall pre-insulated type.

Q. Exposed, round and flat-oval, exhaust-air duct insulation shall be the following:

1. Exposed ductwork in occupied spaces does not require external insulation. Where ductwork is double wall pre-insulated type.

R. Exposed, rectangular, supply-air duct insulation shall be the following:
1. Mineral-Fiber Board: 2 inches (51 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

S. Exposed, rectangular, return/relief-air duct insulation shall be the following:
1. Mineral-Fiber Board: 2 inches (51 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

T. Exposed, rectangular, outdoor-air duct insulation shall be the following:
1. Mineral-Fiber Board: 2 inches (51 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

U. Exposed, rectangular, exhaust-air duct insulation shall be the following:
1. Mineral-Fiber Board: 2 inches (51 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

V. Exposed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

W. Exposed, supply-air plenum insulation shall be the following:
1. Mineral-Fiber Board: 2 inches (51 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

X. Exposed, return/relief-air plenum insulation shall be the following:
1. Mineral-Fiber Board: 2 inches (51 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

Y. Exposed, outdoor-air plenum insulation shall be the following:
1. Mineral-Fiber Board: 2 inches (51 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

Z. Exposed, exhaust-air plenum insulation shall be the following:
1. Mineral-Fiber Board: 2 inches (51 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

AA. Concealed supply air and return/relief air insulation for roof-mounted air handling/heat recovery units shall be the following for the first ten (10) feet of the unit connection:
1. Mineral-Fiber Board: 2 inches (51 mm) thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

BB. All ductwork located in mechanical attic spaces shall be considered as concealed and shall be provided with 3”, .75 Lb/Cu Ft. nominal density, external insulation including all internally lined ductwork (R8 minimum).

3.15 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

C. Chilled-water pump insulation shall be the following:
1. Mineral-Fiber Board: 2 inch thick and 6-lb/cu. ft. (96-kg/cu. m) nominal density.

D. Chilled water expansion / compression tank insulation shall be the following:
   1. Mineral-Fiber Pipe and Tank Wrap: 1 inch (25 mm) thick and 2.5-lb/cu. ft. (40-kg/cu. m) nominal density.
   2. Flexible Elastomeric: 1 inch (25 mm) thick.

E. Chilled-water air-separator insulation shall be the following:
   1. Mineral-Fiber Pipe and Tank Wrap: 1 inch (25 mm) thick and 2.5-lb/cu. ft. (40-kg/cu. m) nominal density.
   2. Flexible Elastomeric: 1-inch (25 mm) thick.

F. Heating Water air-separator insulation shall be the following:
   1. Mineral-Fiber Pipe and Tank Wrap: 1 inch (25 mm) thick and 2.5-lb/cu. ft. (40-kg/cu. m) nominal density.

3.16 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

   1. Drainage piping located in crawl spaces.
   2. Underground piping.
   3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.17 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

   1. All Pipe Sizes: Insulation shall be one of the following:

      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
      b. Flexible Elastomeric: 1 inch (25 mm) thick.

B. Chilled Water Supply and Return Above 40 Degrees F:

   1. Two-inch and Smaller: Insulation shall be the following:

      a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch (38 mm) thick - exposed.

   2. Two and one-half-inch and Larger: Insulation shall be the following:

      a. Mineral-Fiber, Preformed Pipe, Type I: 2 inch (50 mm) thick – exposed.
      b. Pipe insulation wicking system: 2 inch (50 mm) thick – concealed.

   3. Concealed Air Handling Unit Control Valves/Piping Specialties: Flexible/Removable insulation covers with drawstring ends and Velcro fasteners or pre-molded insulation covers.

C. Heating Hot Water Supply and Return, 200 degrees F (93 degrees C) and below:

   1. Two-inches and smaller: Insulation shall be the following:

      a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inches (38 mm) thick.

   2. Two-and one-half inches and larger: Insulation shall be the following:

      a. Mineral-fiber, pre-formed pipe, Type I: 2 inches (50 mm) thick.

   3. Concealed Air Handling Unit Control Valves/Piping Specialties: Flexible/Removable insulation covers with drawstring ends and Velcro fasteners or pre-molded insulation covers.

D. Refrigerant Suction and Hot-Gas Piping (Split Chiller) :

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 2 inch (50 mm) thick.

E. Refrigerant Suction and Hot-Gas Flexible Tubing (Split A/C Systems):

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1 inch (25 mm) thick.

3.18 OUTDOOR, ABOVEGROUND AND ATTIC PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping (Split Chiller):

1. All Pipe Sizes: Insulation shall be the following:
a. Flexible Elastomeric: 3 inches (76 mm) thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing (Split A/C Systems):

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 2 inches (50 mm) thick.

C. Chilled Water:
1. All pipe sizes: Insulation shall be the following:
a. Mineral fiber, pre-formed pipe insulation type - 3 inches thick.

D. Heating Water:
1. All pipe sizes: Insulation shall be the following:
a. Mineral fiber, pre-formed pipe insulation type – 2 inches thick

3.19 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:
1. None.

D. Ducts and Plenums, Exposed to the Occupied Space:
1. PVC 20 miles (0.5 mm) thick

E. Equipment, Concealed:
1. None.

F. Equipment, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):
1. none

G. Equipment, Exposed, Larger Than 48 Inches (1200 mm) in Diameter or with Flat Surfaces Larger Than 72 Inches (1800 mm):
1. none

H. Piping, Concealed:
   1. None.

I. Piping, Exposed to the Occupied Space:
   1. PVC: 20 mils (0.5 mm) thick.

3.20 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping:

   1. Aluminum, Stucco embossed with Z-Shaped Locking Seam: 0.020 inch (0.51 mm) thick.
   2. Aluminum 2-piece tee and fitting covers: .024-inch thickness.
   3. Provide Aluminum Jacketing system for all outdoor insulated piping systems including refrigerant piping.

D. Provide venture clad jacket for all exterior ductwork.

E. Provide Aluminum pipe jacket or 8 oz Fiber Glass Cloth or 8 oz. Canvas type jacket with white pasting/lagging mastic for all interior emergency generator exhaust piping and aluminum pipe jacket for exterior exhaust piping

F. Exterior Refrigerant Tubing

   1. All exterior refrigerant tubing (split A/C systems) shall be provided Airex E-Flex Guard (white) with Class II vapor retarder and UV resistant construction.
   2. All larger refrigerant piping (Split Chiller system) shall be provided with aluminum jacketing system.

END OF SECTION

SECTION 23 09 00 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. Related Sections include the following:

1. Division 23 Section "Meters and Gauges for HVAC Piping" for measuring equipment that relates to this Section.

C. Comply with all code requirements and fire safety requirements.

D. The Automatic Temperature Control System (ATC), tie-in to existing, and Energy Management System (EMS) shall be electric/electronic actuation direct digit control (DDC), BTL BACnet Certified System as manufactured by Johnson Controls – Sole Source. All work associated with the Automatic Temperature Control System shall be performed by personnel regularly employed by the local factory branch office of Johnson Controls.

E. Coordinate controls with controlled equipment. Upon completion of the work, calibrate and adjust all controls for proper function. Electric wiring, power to ATC panels, including interlock wiring for equipment such as air handlers, fans, fan/blower coil units, chillers, boilers, water heaters, terminal heating units, split systems, etc., shall be furnished and installed under this section. The ATC Contractor shall provide transformers, wiring, 120 volt power wiring, power to ATC panels, necessary relays, and controls, etc., not provided under Divisions 26, 27 and 28 for the automation of the ATC/EMS as required by the Sequence of Operation and the Input/Output Schedule. All electrical work shall conform to the applicable requirements of Divisions 26, 27 and 28. All control wiring shall be installed in EMT conduit in accordance with Divisions 26, 27 and 28, except for control wiring to terminal control units located above accessible ceilings, which shall be plenum-rated cable. The electrical contractor shall provide up to 10 data ports for ATC use. The ATC Contractor shall coordinate locations and quantities with The Owner and the Electrical Contractor.

F. All automatic temperature control dampers, valves and separable wells for immersion elements furnished by the Control Manufacturer shall be installed by the Mechanical Contractor or his sheetmetal subcontractor under the Control Manufacturer's supervision.

G. Reference is hereby made for this Contractor to become familiar with Division 25, 27 and 28 of these specifications. Familiarization is for coordination purposes only. The Control Contractor shall provide all necessary relays, contacts, interlock wiring, etc., not provided under Division 26, 27, and 28 for the automation of the ATC and EMS Systems as required by the sequence of operation and input/output schedule. The automatic temperature control Contractor shall provide all power wiring for all control panels including emergency power for the heating water system and Air Handling systems indicated on the drawings. Coordinate where power can be obtained with the Electrical Contractor. The Control Contractor shall coordinate all requirements with the building Fire Alarm System. The Control Contractor shall provide all additional devices and interlock wiring required for the automation of the ATC System and monitoring of the EMS System.

H. Provide all labor, materials, equipment and services necessary for and incidental to furnishing and installing a complete stand-alone Electric/Electronic/DDC Automatic Temperature Control System to meet the requirements of the sequence of operation. The System Supplier shall assume and execute full responsibility to select, furnish, install, connect, test, calibrate, and place into operation all specified components, assemblies, and accessories needed for a complete and functional system of HVAC monitoring and control in full compliance with the requirements of the specifications.

I. The Control Contractor shall provide control and monitoring system devices and sensors that conform to the standards of NFPA 72D. Devices and sensors shall be provided to suit the function of the Input/Output Point Summary shown on the Contract Drawings.

J. The ATC Contractor shall coordinate with Division 23, Mechanical, and shall furnish and install all items necessary to meet the requirements of the Sequence of Operation and the Energy Management System (EMS) indicated on the drawings and as required in this specification. The ATC System shall be one of Direct Digital Control utilizing electric/electronic actuation.

K. The direct digital control system shall include all necessary and specified control equipment properly installed in accordance with the specifications and drawings and shall include, but not be limited to the automatic temperature control and energy management system of the following:

1. Air Handling Units including ERVs and DOAS units
2. Heating System Central Plant (Emergency Power)
3. Cooling System Central Plant.
4. Smoke Dampers/Fire and Smoke Dampers.
5. Ventilation Systems.
6. General Exhaust Systems.
7. Unit Heater/Baseboard Radiation/Convector Control/Radiant Heaters/Cabinets Unit Heaters.
8. Mechanical Room Heat and Ventilation Control.
9. Terminal Control Units
10. Emergency Generator System
11. Miscellaneous Interlock Wiring for Fan Speed Switches, Fan On-Off Switches, Boiler Control Panel, Chiller Control Panel, Time Delays, Heating Units, Heat Recovery Devices, Liquid Sensors, Alarm for sump pumps, domestic water heating system, Mixing Valve, Lighting Controls, Split A/C Units, Monitors, Sump Pumps, Water Heater, Emergency Generator, Site Lighting Systems, flow and water meters, incoming electric service submeter, etc.
12. Provide an Ethernet connection(s) between the building and the existing Johnson Metasys Energy Management System and associated hardware and software for a fully automated remote system.

L. The ATC Contractor shall provide input/output devices and sensors, conduit system and interlock wiring between sensors and the existing Energy Management System. All sensors and devices provided for tie-in to the existing school district energy management system shall be manufactured by Johnson Controls. and installed by the local branch office of Johnson Controls, sole source. The ATC Contractor shall provide input/output devices and sensors, conduit system and interlock wiring between sensors and the existing Energy Management System. All sensors and devices provided for tie-in to the existing school district energy management system shall be manufactured by Johnson Controls, and installed by Johnson Controls local branch office, Sole source. All system controls shall be fully compatible in every way to current district-wide ATC system, whether factory or field assembled. At end of the project these controls must be the latest version and the head end of the system is to be upgraded to the latest version as well for complete compatibility. Use same extended warranty working as was done in prior projects for all components used in the control system.

M. EMS:

1. The Energy Management System (EMS) shall be provided by Johnson Controls. This includes modification of the existing Energy Management System and the furnishing and installing of all hardware, software and accessories required to perform the functions listed and as described hereinafter in the Sequence of Operations.
2. The Contractor shall modify and extend the existing Johnson Controls Energy Management System to enable the expansion of the system to include the monitoring and control of the items indicated in the control point schedule (I/O Summary) and listed in these Contract Documents and Specifications.

3. The Contractor shall provide programming to incorporate the new points into the data file of the existing CPU.

N. The project will require a network control unit(s), central plant controller(s), etc and all auxiliary devices required for a complete system as per specified Sequence of Operation. The ATC Contractor will not be relieved of any responsibility or requirements necessary for a complete and operational ATC System. The ATC System shall be an all-electric/electronic actuation, direct digitally controlled. Coordinate all control requirements with the equipment manufacturers for a fully turnkey system. Extend EMS Interface Communication line and provide all necessary devices, software, etc., for remote control and monitoring form the school district EMS. The EMS shall include all hardware, software, and programming to graphically display the building, equipment and system. The Automatic Temperature Control Contractor shall be Johnson Controls, sole source.

O. The building shall be provided with stand-alone local controls. The Energy Management System shall override local controls when "Local-Remote" System switches are in the remote position. Position of all "Local-Remote" switches shall be monitored by the Energy Management System. If failure of the Energy Management System occurs when the "Local-Remote" System switch is indexed to remote control, all controls functions shall revert back to local controls. Reset to remote controls shall be manual.

1.3 DEFINITIONS

A. DDC: Direct digital control.

B. I/O: Input/output.

C. MS/TP: Master slave/token passing.

D. PC: Personal computer.

E. PID: Proportional plus integral plus derivative.

F. RTD: Resistance temperature detector.

1.4 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within minimum tolerances as follows, unless stricter tolerances are specified for specific devices hereinafter:

    a. Water Temperature: Plus or minus 1 deg F (0.5 deg C).
    b. Water Flow: Plus or minus 5 percent of full scale.
    c. Water Pressure: Plus or minus 2 percent of full scale.

d. Space Temperature: Plus or minus 1 deg F (0.5 deg C).
e. Ducted Air Temperature: Plus or minus 1 deg F (0.5 deg C).
f. Outside Air Temperature: Plus or minus 2 deg F (1.0 deg C).
g. Dew Point Temperature: Plus or minus 3 deg F (1.5 deg C).
h. Temperature Differential: Plus or minus 0.25 deg F (0.15 deg C).
i. Relative Humidity: Plus or minus 5 percent.
j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
l. Airflow (Terminal): Plus or minus 10 percent of full scale.
m. Air Pressure (Space): Plus or minus 0.01-inch wg (2.5 Pa).
n. Air Pressure (Ducts): Plus or minus 0.1-inch wg (25 Pa).
o. Carbon Monoxide: Plus or minus 5 percent of reading.
p. Carbon Dioxide: Plus or minus 50 ppm.
q. Electrical: Plus or minus 5 percent of reading.

1.5 SEQUENCE OF OPERATION

A. Refer to Drawings for Sequence of Operation.

1.6 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Schedule of dampers including size, leakage, and flow characteristics.
7. Schedule of valves including flow characteristics.
8. DDC System Hardware:

   a. Wiring diagrams for control units with termination numbers.
   b. Schematic diagrams and floor plans for field sensors and control hardware.
   c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
10. Controlled Systems:

    a. Schematic and logic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.

c. Written description of sequence of operation including schematic diagram.
d. Points list.
e. Control Systems Network Architecture and Riser Diagram, including all nodes, devices, interfaces, and interconnections.

11. Data Sheets of all products.
12. Points Lists for all physical and virtual (software) points to be provided at minimum, including for each point the tag, type, range, unit's descriptor, address, project specific attributes, and the like.
13. Include in the Points List details of the physical terminations and interconnections for each end device on the networks, including the associated Node, cable terminations, termination location and referenced sequences, special functions to be applied and cross-referenced drawings. All field wiring tags shall be cross-referenced between drawings.
14. Information specifically required by Authorities Having Jurisdiction.
15. Details of the training to be provided, including outlines for each session.
16. Details of the commissioning sheets and procedures proposed.
17. Details of ISP, and associated requirements to be provided by the Owner, at its cost, in order for the contractor to complete the work.
18. Final graphic floor plan with final room numbers.
19. All school district's Standard acronyms.
20. Provide interlock for each Site lighting Contactor and lighting control system

C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with BACnet (BTL Certified).

D. Samples for Initial Selection: For each color required, of each type of thermostat or sensor cover with factory-applied color finishes.

E. Samples for Verification: For each color required, of each type of thermostat or sensor cover.

F. Software and Firmware Operational Documentation: Include the following:

1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.
5. Software license required by and installed for DDC workstations and control systems.

G. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

H. Qualification Data: For Installer and manufacturer.

I. Field quality-control test reports.

J. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project. The Manufacturer shall be Johnson Controls, Inc. (Sole Source).

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with ASHRAE 135 for DDC system components.

D. Supplier shall have an in-place support facility with technical staff, spare parts inventory, and all necessary test and diagnostic equipment.

E. The systems shall be complete in all respects and shall be installed by skilled personnel. The Control Contractor shall have a successful history in the installation and maintenance of automatic temperature control systems similar in size and performance to that specified herein.

F. All electrical wiring in connection with the Automatic Temperature Control System shall be furnished and installed by the ATC Contractor. This shall include all interlock wiring between fans, pumps, heating and cooling systems, heaters, terminal control units, etc.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update the entire building/systems district wide (including existing) to latest version of software at Project completion.

1.9 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment with Division 28 Section "Intrusion Detection" to achieve compatibility with equipment that interfaces with that system and with building master clock.

C. Coordinate equipment with Division 28 Section "Access Control" to achieve compatibility with equipment that interfaces with that system.

D. Coordinate equipment with Division 27 Section "Clock Systems" to achieve compatibility with equipment that interfaces with that system.

E. Coordinate equipment with Division 28 Section "PLC Electronic Detention Monitoring and Control Systems" to achieve compatibility with equipment that interfaces with that system.

F. Coordinate equipment with Division 26 Section "Network Lighting Controls" to achieve compatibility with equipment that interfaces with that system.

G. Coordinate equipment with Division 28 Section "Fire Detection and Alarm" to achieve compatibility with equipment that interfaces with that system.

H. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

I. Coordinate equipment with Division 26 Section "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.

J. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.

K. Coordinate equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

L. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Replacement Materials: One replacement diaphragm or relay mechanism for each unique controller, thermostat, and positioning relay.
2. Maintenance Materials: Three thermostat adjusting keys.
3. Software: Provide back/recovery external hard drive for all software.
4. Sensors: Provide five (5) wall mounted space temperature, relative humidity and carbon dioxide sensors.
5. Unitary controllers: provide five (5) air handling unit unitary controllers.
6. Damper Actuators: Provide two (2) damper actuators for each size and type.
7. Control Valves: provide five (5) air handling unit control valves for each pipe size.

1.11 WORK BY OTHERS

A. Automatic Temperature Control valves and separable wells for immersion elements furnished by the control manufacturer shall be installed by the Mechanical Contractor under the Manufacturer's supervision. The Control Contractor shall deliver to the Mechanical Contractor valves and wells for installation within the various systems.

B. All automatic dampers furnished by the control manufacturer shall be installed by the Mechanical Contractor under the control manufacturer's supervision.

1.12 GUARANTEE AND INSTRUCTION:

A. The control system including all components, system software, parts and assemblies herein specified shall be free from defects in workmanship and materials under normal use and service. After completion of the installation, the Control Manufacturer shall regulate and adjust all thermostats, control valves, control motors, and other equipment provided under this contract. If, within two (2) years from the date of substantial completion, any of the equipment herein described is proved to be defective in workmanship or materials, it will be replaced or repaired at no additional cost to the Owner. The Control Manufacturer shall, after completion, provide any service incidental to the proper performance of the Control System under guarantees outlined above for a period of two (2) years. Normal maintenance of the system is not to be considered part of the guarantee. All corrective modifications made during warranty service periods shall be updated on all user documentation including "as-built" shop drawings and on user and manufacturer archived software external hard drive.

B. The Control Contractor shall completely check out, calibrate and test all connected hardware to insure that the system performs in accordance with the approved specifications and sequences of operation submitted.

C. Upon completion of the work, the control drawing (AutoCAD Drawing printed in color) encased in heavy plastic shall be provided in each mechanical equipment space. Layout shall show all control equipment and the function of each item indicated. All AutoCAD Control Drawings shall be archived on an external hard drive and turned over to the Owner.

D. Upon completion of the work, the Control Contractor shall have completely adjusted the entire control system. He shall arrange to instruct the Owner's representative on the operation of the control system for a period of not less than five (2) eight (8) hour days. All training shall be by the Control Contractor shall be on site and shall utilize specified manuals and as-built documentation. In addition to the start-up instructional period the ATC Contractor shall provide one (1) eight hour instructional period 6 months after the initial instructions and one (1) eight hour instructional period 12 months after the initial instructions (i.e., one during cooling season/one during the heating season).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CONTROL SYSTEM

A. Available Manufacturer:
1. Johnson Controls – Sole Source.

B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.

C. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

2.3 DDC EQUIPMENT

A. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.

1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

a. Global communications.
b. Discrete/digital, analog, and pulse I/O.
c. Monitoring, controlling, or addressing data points.
d. Software applications, scheduling, and alarm processing.
e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

3. Standard Application Programs:

a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
c. Chiller Control Programs: Control function of chilled-water reset and equipment sequencing.
d. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
e. Remote communications.
f. Maintenance management.
g. Units of Measure: Inch-pound and SI (metric).

4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.

B. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.

1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

a. Global communications.
b. Discrete/digital, analog, and pulse I/O.
c. Monitoring, controlling, or addressing data points.

3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.

C. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.

1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.
6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
7. Universal I/Os: Provide software selectable binary or analog outputs.

D. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:

1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

E. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:

1. Minimum dielectric strength of 1000 V.
2. Maximum response time of 10 nanoseconds.
3. Minimum transverse-mode noise attenuation of 65 dB.

4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.4 UNITARY CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.

1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
3. Enclosure: Dustproof rated for operation at 32 to 120 deg F (0 to 50 deg C).
4. Enclosure: Waterproof rated for operation at 40 to 150 deg F (5 to 65 deg C).

2.5 ALARM PANELS

A. Unitized cabinet with suitable brackets for wall or floor mounting. Fabricate of 0.06-inch- (1.5-mm-) thick, furniture-quality steel or extruded-aluminum alloy, totally enclosed, NEMA 1, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish. Provide common keying for all panels. Provide means of storing control system instructions and drawings inside cabinet for future reference. Provide UL listed cabinets for use with line voltage devices.

B. Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted on hinged cover.

1. Alarm Condition: Indicating light flashes and horn sounds.
2. Acknowledge Switch: Horn is silent and indicating light is steady.
3. Second Alarm: Horn sounds and indicating light is steady.
4. Alarm Condition Cleared: System is reset and indicating light is extinguished.
5. Contacts in alarm panel allow remote monitoring by independent alarm company.

2.6 ANALOG CONTROLLERS

A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.

B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F (minus 23 to plus 21 deg C), and single- or double-pole contacts.

C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.

1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.

D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

2.7 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:

1. Available Manufacturers:

   a. Johnson.
   b. Or Equal.

2. Accuracy: Plus or minus 0.5 deg F (0.3 deg C) at calibration point.
3. Wire: Twisted, shielded-pair cable.
4. Insertion Elements in Ducts: 18 inches (460 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
5. Averaging Elements in Ducts: 72 inches (1830 mm) long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft. (1 sq. m).
6. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches (64 mm).
7. Room Sensor Cover Construction: Manufacturer's standard locking covers.

   a. Setpoint adjustment: Exposed.Set-Point Indication: Concealed.
   b. Override Button:
   c. Display: LED.
   d. Color: Standard Manufacturer’s Color.
   e. Orientation: Vertical.”

8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws. Provide for Gymnasium and/or auxiliary gym spaces and room security areas.

C. RTDs and Transmitters:

1. Available Manufacturers:

   a. Johnson
   b. Or Equal

2. Accuracy: Plus or minus 0.2 percent at calibration point.
3. Wire: Twisted, shielded-pair cable.
4. Insertion Elements in Ducts: Single point, 18 inches (460 mm) long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
5. Averaging Elements in Ducts: 24 feet (7.3 m) long, flexible; use where prone to temperature stratification or where ducts are larger than 9 sq. ft. (0.84 sq. m); length as required.
6. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches (64 mm).
7. Room Sensor Cover Construction: Manufacturer's standard locking covers.

   a. Set-Point Adjustment: Concealed.
   b. Set-Point Indication: Concealed.
   c. Thermometer: Concealed.
   d. Color: Manufacturer’s Standard Color.
   e. Orientation: Vertical.

8. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
9. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

D. Smart Humidity Sensors: Bulk polymer sensor element.

1. Manufacturers:

   a. Vaisala or equal of Johnson Controls for space and duct humidity sensors, temperature, relative humidity, dew point, and enthalpy.
   b. Vaisala for outdoor air temperature, relative humidity, enthalpy, dew point, and wet bulb.

2. Accuracy: 2 percent full range with linear output.
3. Room Sensor Range: 20 to 80 percent relative humidity. Vaisala Model Humicap H Sensor.
4. Room Sensor Cover Construction: Manufacturer's standard locking covers.

    a. Set-Point Adjustment: Concealed.
    b. Set-Point Indication: Concealed.
    c. Thermometer: Concealed.
    d. Color: Manufacturer's Standard Color.
    e. Orientation: Vertical.

5. Outside-Air Sensor: 0% to 100% percent relative humidity range with mounting enclosure and wall bracket. Temperature, relative humidity, wet bulb, dew point, and enthalpy measurement with humicap 180R sensor. 2% RH accuracy
6. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity. 1.5% accuracy Vaisala Model HMD60.

E. Pressure Transmitters/Transducers:

1. Available Manufacturers:

    a. BEC Controls Corporation.
    b. General Eastern Instruments.
    c. MAMAC Systems, Inc.
    d. Vaisala.
    e. Rosemount.
    f. Air Monitor, Inc.
    g. Ebtron, Inc.
    h. United Electric.
    i. Ashcroft.
    j. Veris.
    k. Johnson Controls

2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.

    a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
    b. Output: 4 to 20 mA.
    c. Building Static-Pressure Range: 0- to 0.25-inch wg (0 to 62 Pa).
    d. Duct Static-Pressure Range: 0- to 5-inch wg (0 to 1240 Pa).
    Duct Static Pressure Traverse Probes. Provide where indicated duct static traverse probe capable of continuously monitoring the duct or system static pressure it serves. Each duct static traverse probe shall contain multiple static pressure sensors located along the exterior surface of the cylindrical probe. Said sensors shall not protrude beyond the surface of the probe. The duct static traverse probe shall be of extruded aluminum construction and (except for 3/4" diameter probes with lengths of 24" or less) be complete with threaded end support rod, sealing washer and nut, and mounting plate with gasket and static pressure signal fitting. The static traverse probe shall be capable of producing a steady, non-pulsating signal of standard static pressure, without need for correction factors, with an instrument accuracy of 0.5%^. The duct static pressure traverse probe shall be the STAT-Probe/1 as manufactured by the Air Monitor Corporation or Gold Series by Ebtron.
    e. Electronic Velocity Pressure Transmitters. The electronic differential pressure/flow transmitters shall be of industrial process control quality with operating features described herein and capable of producing the outlined performances. The transmitter shall be capable of converting signals of static or differential pressure into a 4-20 mADC output signal linear to the sensed pressure. By means of an integral, user-selectable, square root extractor, the transmitter shall be capable of converting the total and static pressure signals for a flow element into a 4-20 mADC output signal linear to airflow velocity or volume, the transmitter shall be furnished with a built-in 3-way zeroing valve. The transmitter shall be furnished within an aluminum NEMA 1 enclosure with external connection terminals for field wiring. The operating span of the transmitter shall have the capability of factory or field calibration down to 40% of its natural span and the transmitter shall meet or exceed the following performance and application criteria.

        Square Root Extractor: Integral - User-selectable.

Zeroing:	Integral - Manual with 3-way switch. (7) Natural Spans, from 0 - .10 IN w.c. to 0-10.0 IN w.c. (7) Bi-Polar Spans
Accuracy:	+/-0.5% of Natural Span, including non-linearity, hysteresis, and non-repeatability.
Temperature Effect:	Zero: 0.015% of Natural Span / EF.
Span:	0.015% of Natural Span / EF.
Power Supply:	14-40VDC
Power Consumption:	0.5 Watts at 24 VDC
Output Signal:	4-20mADC, 2-wire configuration.
Overpressure Limit:	25 psig.

f. The transmitter shall be the VELTRON DPS 2500 plus as manufactured by Air Monitor Corporation, or Gold Series by Ebtron or equal product by Ashcroft.

3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure; linear output 4 to 20 mA.
4. Water Differential-Pressure Transmitter: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure and tested to 300-psig (2070-kPa); linear output 4 to 20 mA. – Rosemount 2051 DP or equal of Veris.
5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential – United Electric H105K sole source.
6. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

F. Room Sensor Cover Construction: Manufacturer's standard locking covers.

1. Set-Point Adjustment: Concealed.
2. Set-Point Indication: Concealed.
3. Thermometer: Concealed.
4. Color: Architect shall select.
5. Orientation: Vertical.

G. Room sensor accessories include the following:

1. Insulating Bases: For sensors located on exterior walls.
2. Guards: Locking, solid metal, ventilated.
3. Adjusting Key: As required for calibration and cover screws.

H. Static Pressure Sensors.

1. Shielded Room Space Static Pressure Sensor: Provide for each room or space, a shielded static pressure sensor suitable for wall or ceiling surface flush-mounting, complete with multiple sensing ports, pressure impulse suppression chamber, airflow shielding, and 3/8" FPT takeoff fitting, all contained in a 10 gauge aluminum welded casing, with brush finish on exposed surfaces. These probes shall be capable of sensing the static pressure in the proximity of the sensor to within 1% of the actual pressure value while being subjected to a maximum airflow of 1000 fpm from a radial source. The shielded room or space static pressure sensors shall be the S.A.P./ 3 Shielded Static Air Probes as manufactured by Air Monitor Corporation, or as approved equal.
2. Shielded Plenum Static Pressure Sensor: Provide where indicated for each plenum two shielded static pressure sensors suitable for mounting externally on the plenum wall in opposing positions. The plenum pressure sensors shall be complete with multiple sensing ports, pressure impulse suppression chamber, airflow shielding, and 3/8" compression elbow takeoff fitting, all contained in a 10 gauge steel welded casing. With polyurethane paint finish on exposed surfaces. These probes shall be capable of sensing the static pressure of the plenum or duct in the proximity of the sensor to within 1% of the actual pressure value. The shielded plenum static pressure sensors shall be the S.A.P./4 Shielded Static Air Probe, as manufactured by Air Monitor Corporation, Santa Rosa, California.
3. Outdoor Static Pressure Sensor: Provide for the room or space static pressure indicating or controlling systems an outdoor static pressure sensor constructed of 10 gauge anodized aluminum with a 2" diameter FPT connection. The outdoor air probe shall be capable of sensing the outside

atmospheric air pressure to within 2% of the actual value when subject to radial wind velocities up to 80 miles per hour with approach angles up to 30 degrees to the horizontal. Locate where recommended by the Manufacturer. The Static Outside Air Problem shall be the S.O.A.P., as manufactured by Air Monitor Corporation, or as approved equal.

4. Duct Static Pressure Traverse Probe: Provide where indicated, duct static traverse probes capable of continuously monitoring the duct or system static pressure it serves. Each duct static traverse probe shall contain multiple static pressure sensors located along the exterior surface of the cylindrical probe. Said sensors shall not protrude beyond the surface of the probe. The duct static traverse probes shall be of extruded aluminum construction and (except for 3/4" diameter probes with lengths of 24" or less) shall be complete with threaded end support rod, sealing washer and nut, and mounting plate with gasket and static pressure signal fitting. The static traverse probes shall be capable of producing a steady, non-pulsating signal of standard static pressure, without need for correction factors, with an instrument accuracy of 1%. The duct static pressure traverse probes shall be the STAT-probe as manufactured by Air Monitor Corporation, or Ebtron.

2.8 STATUS SENSORS

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg (0 to 1240 Pa).

B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig (55 to 414 kPa), piped across pump.

C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

1. Available Manufacturers:

   a. BEC Controls Corporation.
   b. I.T.M. Instruments Inc.
   c. McDonald Miller.
   d. Johnson Controls.
   e. Penn Controls.

2.9 GAS DETECTION EQUIPMENT

A. Available Manufacturers:

1. B. W. Technologies.
2. CEA Instruments, Inc.
3. Ebtron, Inc.
4. Gems Sensors Inc.

5. Greystone Energy Systems Inc.
6. Honeywell International Inc.; Home & Building Control.
7. INTEC Controls, Inc.
8. I.T.M. Instruments Inc.
9. MSA Canada Inc.
10. QEL/Quatrosense Environmental Limited.
11. Sauter Controls Corporation.
12. Sensidyne, Inc.
13. TSI Incorporated.
14. Vaisala.
15. Johnson
16. Blimo

B. Carbon Monoxide Detectors: Provide at each boiler, between each water heater, at the indoor emergency generator and in the first room served by a gas fired furnace. Single or multichannel, dual-level detectors using solid-state plug-in sensors with a 3-year minimum life; suitable over a temperature range of 32 to 104 deg F (0 to 40 deg C); with 2 factory-calibrated alarm levels at 50 and 100 or 35 and 200 ppm.

C. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F (minus 5 to plus 55 deg C) and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output; for wall mounting. Measurement range shall be 0-2000 ppm, accuracy shall be 30 ppm, repeatability shall be +/-1% full scale, long term stability shall be 75 ppm at 60-100 ppm over 5 years. Vaisala Carbocap GMD/W Series or equal of Veris or Johnson.

D. Oxygen Sensor and Transmitter: Single detectors using solid-state zircon cell sensing; suitable over a temperature range of minus 32 to plus 1100 deg F (0 to 593 deg C) and calibrated for 0 to 5 percent, with continuous or averaged reading, 4- to 20-mA output; for wall mounting.

E. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment; for flush mounting.

2.10 FLOW MEASURING STATIONS

A. Duct Airflow Station: Combination of air straightener and multiport, self-averaging pitot tube station. Locations shall be determined on site with the Manufacturer's Representative, Owner, Engineer and Commissioning Agent. Additionally the Manufacturer's Representative shall be on site during the time of installation.

1. Available Manufacturers:

   a. Air Monitor Corporation.
   b. Ebtron, Inc.
   c. Johnson Controls.

2. Casing: Galvanized-steel frame.
3. Flow Straightener: Aluminum honeycomb, 3/4-inch (20-mm) parallel cell, 3 inches (75 mm) deep.
4. Sensing Manifold: Copper manifold with bullet-nosed static pressure sensors positioned on equal area basis.
5. Duct-Mounted: Provide where indicated, air flow measuring stations with air straighteners capable of continuously monitoring the fan or duct capacities (air volumes) they serve. Each airflow measuring station shall contain multiple total and static pressure sensors positioned at the center of equal area of the station cross-section and interconnected by their respective averaging manifolds. For stations of 4 square feet or less, one total and one static pressure sensor sensor shall be present for every 16 square inches of station area respectively. For stations of larger area, one total and one static pressure sensor shall be present for every 36 square inches of station area respectively. The airflow measuring station shall be fabricated of a minimum of 14 gauge galvanized steel, welded casing in 8" depth with 90 degree connecting flanges in a configuration and size equal to that of the duct it is to be mounted into. Each station shall be complete with an open parallel cell air straightener or air equalizer honeycomb mechanically fastened to the casing, total and static pressure sensors located on an equal area basis and connected to symmetrical averaging manifolds, internal piping, and external pressure transmitter ports. An identification label

shall be placed on each station casing listing model number, size, area, and specified airflow capacity. The maximum allowable pressure loss through the station shall not exceed .015" wc at 1000 fpm, or .085" wc at 2000 fpm. Each station shall be capable of measuring the airflow rate within an accuracy of 2 percent as determined by U.S.G.S.A. Certification Tests. The stations shall have a self-generated sound rating of less than NC 40, and the sound level within the duct shall not be amplified, nor shall additional sound be generated. The airflow measuring stations shall be the Fan-Evaluator or Duct Air Monitor Device as manufactured by Air Monitor Corporation, or as approved equal of Ebtron.

6. Outdoor Air Flow Station: The outdoor air flow station shall be Air Monitor, Inc. VOLU-FLO/OAM sole source. Locate airflow measuring device upstream of the outside air damper in accordance with the manufacturer's installation requirements. Provide appropriate mounting brackets and expanded metal grid.
7. At the contractor's option, air handling equipment can be provided with an integral air flow measuring station and damper control for minimum and economizer outside air and relief air measuring.

2.11 THERMOSTATS

A. Available Manufacturers:

1. Johnson Controls

B. Combination Thermostat and Fan Switches: Line-voltage thermostat with push-button or lever-operated fan switch.

1. Label switches "FAN ON-OFF"; "FAN HIGH-LOW-OFF"; or "FAN HIGH-MED-LOW-OFF".
2. Mount on single electric switch box.

C. Electric, solid-state, microcomputer-based room thermostat with remote sensor.

1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from set point.
3. Set up for four separate temperatures per day.
4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
5. Short-cycle protection.
6. Programming based on weekday, Saturday, and Sunday or every day of week.
7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
8. Battery replacement without program loss.
9. Thermostat display features include the following:

   a. Time of day.
   b. Actual room temperature.
   c. Programmed temperature.
   d. Programmed time.
   e. Duration of timed override.
   f. Day of week.
   g. System mode indications include "heating," "off," "fan auto," and "fan on."

D. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.

E. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F (13 to 30 deg C) set-point range, and 2 deg F (1 deg C) maximum differential.

1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.

2. Selector Switch: Integral, manual on-off-auto.

F. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.

1. Bulbs in water lines with separate wells of same material as bulb.
2. Bulbs in air ducts with flanges and shields.
3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

G. Fire-Protection Thermostats: Listed and labeled by an NRTL acceptable to authorities having jurisdiction; with fixed or adjustable settings to operate at not less than 75 deg F (24 deg C) above normal maximum operating temperature, and the following:

1. Reset: Manual.
2. Reset: Automatic, with control circuit arranged to require manual reset at central control panel; with pilot light and reset switch on panel labeled to indicate operation.

H. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

I. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, automatic-reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or below set point.

1. Bulb Length: Minimum 20 feet (6 m).
2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.

J. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- automatic- reset switch that trips if temperature sensed across any 12 inches (300 mm) of bulb length is equal to or above set point.

1. Bulb Length: Minimum 20 feet (6 m).
2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.

K. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig (172 kPa), and cast housing with position indicator and adjusting knob.

2.12 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
4. Spring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).
5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).

6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Manufacturers:

   a. Belimo Aircontrols (USA), Inc.
   b. Johnson Controls

2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
3. Dampers: Size for running torque calculated as follows:

   a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. (86.8 kg-cm/sq. m) of damper.
   b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. (62 kg-cm/sq. m) of damper.
   c. Dampers with 2- to 3-Inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by 1.5.
   d. Dampers with 3- to 4-Inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): Increase running torque by 2.0.

4. Coupling: V-bolt and V-shaped, toothed cradle.
5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
7. Power Requirements (Two-Position Spring Return): 24-V ac.
8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
10. Temperature Rating: Minus 22 to plus 122 deg F (Minus 30 to plus 50 deg C).
11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F (Minus 30 to plus 121 deg C).
12. Run Time: 30 seconds.

C. Ball Valves: Bronze body, stainless steel trim characterized ball valves shall be acceptable for terminal unit control valves.

D. Do not use floating type control valves.

2.13 CONTROL VALVES

A. Available Manufacturers:
1. Bray (Butterfly Valves).
2. DeZurick (Butterfly Valves).
3. Jamesbury (Butterfly Valves).
4. Keystone (Butterfly Valves).
5. Milwaukee (Butterfly Valves).

B. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated. Valves shall be provided with a positioning relay.

C. Hydronic system globe valves shall have the following characteristics:

1. NPS 2 (DN 50) and Smaller: Class 125 bronze body, stainless steel trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
2. NPS 2-1/2 (DN 65) and Larger: Class 125 iron body, stainless steel trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.

   a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
   b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.

4. Sizing: 5-psig (35-kPa) maximum pressure drop at design flow rate or the following:

   a. Two Position: Line size.
   b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
   c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.

5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.

D. Butterfly Valves: Refer to Section 230523, General Duty Valves for HVAC Piping.

1. Sizing: 1-psig (7-kPa) maximum pressure drop at design flow rate.

E. Terminal Unit Control Valves: Bronze body, stainless steel trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.

1. Rating: Class 125 for service at 125 psig (860 kPa) and 250 deg F (121 deg C) operating conditions.
2. Sizing: 3-psig (21-kPa) maximum pressure drop at design flow rate, to close against pump shutoff head.
3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

F. Self-Contained Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.

1. Rating: Class 125 for service at 125 psig (860 kPa) and 250 deg F (121 deg C) operating conditions.
2. Thermostatic Operator: Wax or Liquid-filled remote sensor with integral adjustable dial.

2.14 DAMPERS

A. Available Manufacturers:

1. Air Balance Inc.
2. American Warming and Ventilating
3. Ruskin, Inc.
4. Johnson Controls

B. Dampers: AMCA-rated, Class I, parallel-blade (two-position type) and opposed-blade (proportional control type) design; airfoil shaped double skin construction of 14 gauge equivalent thickness, galvanized frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- (1.6-mm-) thick galvanized steel with maximum blade width of 6 inches and length of 48 inches. Provide spring returns for all dampers. Dampers shall be Ruskin Type CD60, or equal of American Warming and Ventilating or Air Balancing, Inc. Round dampers shall be Ruskin Type CER 325.

1. Secure blades to 1/2-inch- (13-mm-) diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).
3. Edge Seals, Ultra-Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. (50 L/s per sq. m) of damper area, at differential pressure of 4-inch wg (1000 Pa) when damper is held by torque of 50 in. x lbf (5.6 N x m); when tested according to AMCA 500D.

2.15 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Division 27 Section "Communications Horizontal Cabling."

B. All wiring shall be installed in a designated EMT conduit raceway unless otherwise specified. All junction boxes shall have covers painted “Safety Green” and be rigid steel. Minimum size conduit shall be 3/4”.

C. Where it is not possible to conceal raceways in finished locations (i.e., existing masonry walls), surface raceway (wiremold) may be used as approved by the Architect.

D. Individual conductors shall be color-coded and in addition, shall be numbered in the field to identify the particular terminal to which it is attached. Field numbering shall be performed with Brady Markers wrapped around the wire near the terminal connection. All wires shall be terminated with pressure type connectors suitable for wire size, material, and terminal connection.

2.16 DUCT SMOKE DETECTORS

A. Duct Smoke Detectors shall be provided in all air handling (DOASs, AHU’s, FCU’s) supply and return air systems with an air flow of 2000 cfm or greater and in return air systems for each floor in accordance with NFPA requirements. They shall be designed to provide detection of combustion gases and fire and smoke in air conditioning and ventilating duct systems in compliance with the National Fire Protection Association and Underwriters Laboratories, Inc. Standard UL 167. Duct smoke detectors shall be furnished by the Electrical Contractor and installed by the Mechanical Contractor. The ATC contractor shall coordinate location, size, and quantity with the electrical contractor. The Mechanical Contractor shall provide all interlock wiring to smoke dampers and/or AHU shutdown. The Electrical Contractor shall provide all interlock wiring to the Fire Alarm System and all power wiring. Coordinate duct smoke detector types, quantity of contacts, etc., so as to interface directly with the fire alarm system. Coordinate requirements with Divisions 26, 27, and 28.

2.17 WATER METERS

A. Water submeters shall be NSF 61/ANSI 372 certified. Water meters shall be electromagnetic or pulse type by Badger, Hersey or equal. Monitor gallons of usage and alarm when high water flow rates are sensed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that power supply is available to control units and operator workstation.

B. Verify that duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.2 INSTALLATION

A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. The Automatic Temperature Control System shall be designed, installed, and commissioned in a fully turnkey, fully implemented and fully operational manner.

D. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches (1220 mm) above the floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

E. Install guards for all wall sensors (temperature, carbon dioxide, relative humidity, etc.)

F. Install automatic dampers according to Division 23 Section "Air Duct Accessories."

G. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

H. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."

I. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."

J. Install refrigerant instrument wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping."

K. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

L. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

M. Duct smoke detectors shall be furnished by the Electrical Contractor and installed by the Mechanical Contractor. The mechanical Contractor shall provide all interlock wiring to smoke dampers and/or AHU shutdown. The Electrical Contractor shall provide all interlock wiring to the fire alarm system and associated power wiring.

N. All safety controls shall be hard-wired so as to be functional in the hand/manual or automatic mode.

O. The ATC Contractor shall be responsible to provide all power to ATC panels, controllers and devices. Provide emergency power to all heating plant control systems. Coordinate obtaining power for ATC Systems with the Electrical Contractor. A few circuits, not all, have been identified for ATC use.

P. Locate spare carbon dioxide and or relative humidity sensors adjacent to space temperature sensors. Where space temperature sensors are installed within return air ductwork, locate sensors on exterior walls.

Q. All sensors located on exterior walls shall be provided with an insulated sub base.

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."

1. Install cable in rigid conduit in all mechanical equipment rooms.
2. Install exposed cable in raceway.
3. Install concealed cable in raceway except where above accessible ceilings.
4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.

5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
8. All conduits and raceways shall be installed level, plumb, at right angles to the building lines, and shall follow the contours of the building line.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

F. All Wiring and tubing shall be properly supported and run in a neat and workmanlike manner. All wiring and tubing exposed and in equipment rooms shall run parallel to or at right angles to the building structure. All piping and wiring within enclosures shall be neatly bundled and anchored to prevent restriction to devices and terminals.

G. The Control Contractor shall be responsible for all electrical installation required for a fully functional control and automation system and not shown on the electrical plans or required by the electrical specifications. All wiring shall be in accordance to all local and national codes.

1. All line voltage wiring, all wiring exposed, and all wiring in equipment rooms shall be installed in conduit in accordance to the electrical specifications.
2. All electric and electronic wiring shall be #18 AWG minimum THHN and shielded if required.
3. All wiring in the central control room shall be concealed in an approved manner.

H. Control Systems Wiring:

1. All conduit raceways, wiring, accessories and wiring connections required for the installation of the Controls Systems shall be provided by the Controls Contractor. All wiring shall comply with the requirements of applicable portions of the Electrical Trade work and all local and national electric codes and the requirements of the AHJ.
2. All Controls Systems wiring materials and installation methods shall comply with the original equipment manufacturer recommendations and standards.
3. The sizing type and provision of cable, conduit, cable trays and raceways shall be the design responsibility of the Controls Contractor.
4. Class 2 Wiring
   a. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.
   b. Conduit is not required for Class 2 wiring in concealed accessible ceiling locations. Class 2 wiring not installed in conduit shall be supported every 5ft. from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines.
5. Class 2 signal wiring and 24VAC power may be run in the same conduit. Power wiring 120VAC and greater shall not share the same conduit with Class 2 signal wiring.
6. Perform circuit tests using qualified personnel only. Provide necessary instruments and equipment to demonstrate that:
   a. All circuits are continuous and free from short circuits and grounds.
   b. All circuits are free from unspecified grounds; that resistance to ground of all circuits is no less than 50 megaohms.
   c. All circuits are free from induced voltages.
7. Provide complete testing for all cables and wiring. Provide all equipment, tools, and personnel as necessary to conduct these tests.
8. Provide for complete grounding of all signal and communication cables, panels and equipment so as to ensure integrity of Controls Systems operation. Ground cabling and conduit at panel terminations. Do not create ground loops

I. Line Voltage Power Sources

1. 120 -volt AC circuits for the Controls Systems shall be taken by the Controls Contractor from electrical trade panelboards and circuit breakers. Coordinate locations with the Electrical Contractor.
2. Circuits used for the Controls Systems shall be dedicated to these Controls Systems and shall not be used for any other services.
3. Controls DDC terminal unit controllers may use 120-volt AC power from motor power circuits.

J. Controls Systems Raceways

1. All wiring shall be installed in conduit or raceway except as noted elsewhere in the Specification. Minimum conduit size 3/4".
2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.
3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the supporting surface.
4. UL//ULC Listed Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls and for final connection to equipment.

K. Penetrations:

1. Firestopping for all penetrations used by dedicated Controls Systems conduits and raceways shall be by the ATC Contractor.
2. All openings in fire proofed or fire stopped components shall be closed by the ATC Contractor using approved fire resistive sealant.
3. All wiring passing through penetrations, including walls, shall be in sleeves, conduit or enclosed raceway.
4. No penetrations through building structural elements, slabs, ceilings and walls shall be made before receipt of written approval from the Architect.

L. Controls Systems Identification Standards:

1. Node Identification: All nodes shall be identified by a permanent label fastened to the outside of the enclosure. Labels shall be suitable for the node environmental location.
2. Cable shall be labeled at every termination with cross-referencing to record documentation.
3. Raceway Identification: Exposed covers to junction and pull boxes of the FMS raceways shall be identified at primary points.
4. Wire Identification: All low and line voltage wiring shall be identified by a number, as referenced to the associated shop and record drawing, at each termination.
5. Wires and cabling shall not be spliced between terminations. Cable shields shall be single end grounded – typically at the panel end outside the panel.
6. Suggested color coding, for use at the Contractors option, are:

a.	Analog Input Cable	Yellow
b.	Analog Output Cable	Tan
c.	Binary Input Cable	Orange
d.	Binary Output Cable	Violet
e.	24 VAC Cable	Gray
f.	General Purpose Cable	Natural
g.	Tier 1 Comm Cable	Purple
h.	Other Tier Comm Cable	Blue

M. Field Panel and Device Installations and Locations:

1. The Controls Systems panels, enclosures and cabinets shall be located as coordinated with the Architect at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
2. All field devices shall be installed per the manufacturer recommendation and in accessible locations as coordinated with the Architect.
3. Panels to be located in damp areas or areas subject to condensation shall be mounted with wall standoffs.

4. Conduit configurations entering or leaving panels and devices shall be such as to preclude condensation traps.

N. Controls Specific Installation Requirements

1. The Mechanical Trade Contractor shall install all in-line mechanical devices including temperature wells, pressure taps, duct smoke detectors, airflow stations, etc.
2. Controls DDC terminal unit controllers may use 120-volt AC power from motor power circuits.
3. The Mechanical Contractor shall install all in-line devices including control valves, dampers, etc.
4. Input flow measuring devices shall be installed in compliance with ASME Guidelines.
5. Outside Air Sensors:
   a. Sensors shall be mounted on a wall selected to minimize solar radiant heat impact or be located in a continuous intake flow adequate to monitor outside air conditions accurately.
   b. Sensors shall be installed with a rain shield and perforated cover.
6. Water Differential Pressure Sensors:
   a. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
   b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
   c. The transmitters shall be installed in an accessible location wherever possible.
7. Medium to High Differential Water Pressure Applications (Over 21” wg): Air bleed units, bypass valves and compression fittings shall be provided.
8. Differential Air Pressure Applications (-1” to +1” wg):
   a. Transmitters exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.
   b. The interior tip shall be inconspicuous and located as shown on the drawings.
9. Air Flow Measuring Station:
   a. Where the stations are installed in insulated ducts, the airflow passage of the station shall be the same size as the inside airflow dimension of the duct.
   b. Station flanges shall be two inch to three inch to facilitate matching connecting ductwork.
10. Duct Temperature Sensors:
    a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
    b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
    c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists, such as a mixed air plenum, utilize an averaging sensor.
    d. The sensor shall be mounted to suitable supports using factory approved element holders.
11. Low Temperature Limit Switches:
    a. Install on the discharge side of the first water or steam coil in the air stream.
    b. Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
    c. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.
12. Air Differential Pressure Status Switches: Install with static pressure tips, tubing, fittings and air filter.
13. Water Differential Pressure Status Switches: Install with shut off valves for isolation.
14. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.
15. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.

16. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI. The maximum pressure drop for steam applications shall be 7 PSI.
17. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Controls Systems is to be connected to an external control system as an input (such as chiller control panel), or it is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between building systems. Provide optical isolation between building systems.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect**,** test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
4. Test each point through its full operating range to verify that safety and operating control set points are as required.
5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
6. Test each system for compliance with sequence of operation.
7. Test software and hardware interlocks.
8. Provide complete testing for all cables and wiring. Provide all equipment, tools and personnel as necessary to conduct these tests.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check installation of air supply for each instrument.
6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
8. Check temperature instruments and material and length of sensing elements.
9. Check control valves. Verify that they are in correct direction.
10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
11. Check DDC system as follows:
    a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    c. Verify that spare I/O capacity has been provided.
    d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:

   a. Check analog inputs at 0, 50, and 100 percent of span.
   b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
   c. Check digital inputs using jumper wire.
   d. Check digital outputs using ohmmeter to test for contact making or breaking.
   e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:

   a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
   b. Manually operate flow switches to verify that they make or break contact.

6. Pressure:

   a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
   b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:

   a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
   b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments: Within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to twenty (20) visits to Project during other than normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

B. Schedule instruction with Owner. Provide at least a 7-day notice to the Contractor and Engineer of training date. All Operation and Maintenance Manuals shall be provided to Owner three (3) weeks prior to training. Contractor shall be responsible for all operation and maintenance until Owner has had training.

C. Owner’s Instructions: Provide services of manufacturer’s technical representative to completely instruct Owner in all aspects of system maintenance and operation; or a minimum of five (5) 8-hour days to instruct Owner’s personnel in operation and maintenance of electric control system. The ATC Contractor shall submit a functional test check list including all points and sequence of operation points to be reviewed and

verified during the Owner Instruction Period. All sequences shall be tested for all air handling systems, heating plant and cooling plant systems, and 100% of all terminal units (terminal heating units, fan coil/blower coil units, VAV control unit(s), etc., for each air handling unit zone. The check list shall include columns for “satisfactory”, “unsatisfactory”, and “comments” for each line item. The check list shall be submitted and reviewed as a shop drawing prior to the instructional period. The Contractor shall include all the check lists in a 3-ring binder (10 copies/sets minimum) for the representatives for the instructional procedure.

3.7 LOCAL CONTROL AND EMS CONTROL:

A. For the central heating and chilled water system, each air handling unit system, each terminal control unit, and as required in the I/O Summary as indicated on the drawings, provide a panel-mounted Hand-Off-Automatic Switch, “Local Control” – “EMS Control” – “Off” switch that allows for the Ems or local controls to start-stop systems and/or equipment.

B. Each system shall operate automatically as described in the sequence of operations when locally controlled; i.e., in the hand position and/or when loss of communications of the remote EMS occurs.

C. Refer to Drawings for additional information.

3.8 VERIFICATION

A. Fully test and verify all aspects of the Controls Systems Contract work on a point/system/integrated operational basis for all points, features and functions specified.

B. Acceptance Check Sheet

1. Prepare a check sheet that includes all pints and functions of the Work.
2. Submit the check sheet to the Architect for approval 60 days prior to testing.
3. Complete the check sheets for all items and functions of the work. Initial each entry with time/date as record of having fully calibrated and tested the Work. Submit to the Architect as record.
4. The Architect will use the check sheets as the basis for Acceptance Testing with the Controls Systems Contractor.

C. Provide all necessary specialist labor, materials and tools to demonstrate to the Architect that the Controls Systems have been verified and are operating in compliance with the Controls Systems Contract. Prepare a list of noted deficiencies signed by both the Architect and the Controls Contractor.

D. Contractor shall submit a functional test check list including all points and sequence of operation points to be reviewed and verified during the Owner Instruction Period. All sequences shall be tested for all systems and equipment. The check list shall include columns for SATISFACTORY, UNSATISFACTORY, and COMMENTS for each line item. The check list shall be submitted and reviewed as a shop drawing prior to the instructional period. The Contractor shall include all the check lists in 3-ring binder (10 copies/sets minimum) for the representatives for the instructional procedure.

E. Promptly rectify all listed deficiencies and submit in writing to the Architect a signed report that this has been done.

F. The Architect will retest the deficiencies in conjunction with the controls Contractor at the Architect’s option.

3.9 DATA CONTROL

A. The following P & ID's show the hardware devices required to be connected to the remote electronic panels, and the standard control software modules to be implemented. In addition, all additional software required to accomplish the detailed sequence of operations specified within this section shall be provided.

The following pages also include pseudo points required to be provided for display in logical groups and graphics. Commandable pseudo points shall be commandable directly from all displays.

B. Each analog point shall have unique remote panel resident dual high and dual low limit alarm thresholds as specified elsewhere set in engineering units. Where specified, floating (a band above and below a set point) alarm limits shall be provided.

C. Each digital output shall have a software-associated monitored input. Any time the monitored input does not track its associated command output within a programmable time interval, a "command failed" alarm shall be reported.

D. Where calculated points (such as CFM) are shown, they shall appear in their respective logical groups. The respective unconditioned raw data (such as the logarithmic differential pressure) points shall also be grouped in a special group for display and observation independent of the logical groups.

E. Where data or control points are required to accomplish the digital control or energy management sequences specified but not listed in the summary, the Contractor shall notify the Architect in writing at least fourteen (14) days prior to bid opening. If this timely notification is not received by the Architect, all points required by the sequences shall be provided.

F. Unless otherwise specified or approved prior to bidding, the primary analog input and the analog output of each DDC loop shall be resident in a single remote panel containing the DDC algorithm, and shall function independently of any peer or mux communication links. Secondary (reset type) analog inputs may be received from the peer network, but approved default values and/or procedures shall be substituted in the DDC algorithm for this secondary input if network communications fail or if the secondary input becomes erroneous or invalid.

END OF SECTION

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Hot-Water Heating Piping.
2. Chilled Water piping.
3. Makeup-water piping.
4. Blowdown-drain piping.
5. Air-vent piping.
6. Safety-valve-inlet and -outlet piping.

B. Related Sections include the following:

1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.3 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.

B. RTRF: Reinforced thermosetting resin (fiberglass) fittings.

C. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

1. Hot Water Heating Piping: 125 psig (815 kPa) at 200 deg F (93 deg C).
2. Chilled Water Piping: 125 psig (815 kPA) at 200 deg F (66 deg C).
3. Makeup-Water Piping: 80 psig (552 kPa) at 150 deg F (66 deg C).
4. Air-Vent Piping: 200 deg F (93 deg C).
5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.5 SUBMITTALS

A. Product Data: For each type of the following:

1. Plastic pipe and fittings with solvent cement.
2. RTRP and RTRF with adhesive.

3. Pressure-seal fittings.
4. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
5. Air control devices.
6. Hydronic specialties.

B. Shop Drawings: Detail, at 3/8 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Welding certificates.

D. Qualification Data: For Installer.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

G. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
2. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by the manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

1.7 EXTRA MATERIALS

A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A).

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Wrought-Copper Fittings: ASME B16.22.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. Anvil International, Inc.
b. S. P. Fittings; a division of Star Pipe Products.
c. Victaulic Company of America.

E. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, galvanized steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Charlotte Pipe and Foundry Company.
   b. IPEX Inc.
   c. KBi.
3. CPVC and PVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.

B. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Charlotte Pipe and Foundry Company.
   b. IPEX Inc.
   c. KBi.
2. MSS SP-107, CPVC and PVC union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials. Dielectric unions and couplings are prohibited.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Flanges:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
3. Factory-fabricated companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

D. Dielectric-Flange Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.

2. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
3. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Perfection Corporation; a subsidiary of American Meter Company.
   b. Precision Plumbing Products, Inc.
   c. Sioux Chief Manufacturing Company, Inc.
   d. Victaulic Company of America.

2. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.6 VALVES

A. Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

C. Bronze, Calibrated-Orifice, Manual Balancing Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

   a. Nu-Tech.
   b. Bell & Gossett Domestic Pump; a division of ITT Industries.
   c. Flow Design Inc.
   d. Gerand Engineering Co.
   e. Griswold Controls.
   f. Taco.

2. Body: Bronze, ball or plug type with stainless steel calibrated orifice or venturi.
3. Ball and stem: Stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig (860 kPa).
10. Maximum Operating Temperature: 250 deg F (121 deg C).

D. Cast-Iron or Steel, Calibrated-Orifice, Manual Balancing Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. Nutech.
b. Flow Design Inc.
c. Griswold Controls.
d. Nexus.
e. Bell and Gossett.

2. Body: Cast-iron or steel body, ball, plug, or globe pattern with stainless steel calibrated orifice or venturi.
3. Ball and stem: Stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig (860 kPa).
11. Maximum Operating Temperature: 250 deg F (121 deg C).

E. Diaphragm-Operated, Pressure-Reducing Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Watts Regulator Co.; a Division of Watts Water Technologies, Inc., or a comparable product by one of the following:

a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett Domestic Pump; a division of ITT Industries.
d. Conbraco Industries, Inc.
e. Spence Engineering Company, Inc.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: Stainless steel, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Diaphragm-Operated Safety Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Watts Regulator Company, a Division of Watts Water Technologies, Inc., or a comparable product by one of the following:

a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett Domestic Pump; a division of ITT Industries.
d. Conbraco Industries, Inc.
e. Spence Engineering Company, Inc.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: Stainless steel, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Automatic Flow-Control Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide AutoFlow Model FVT with stainless steel trim or a comparable product by one of the following:

   a. Flow Design Inc.
   b. Griswold Controls.
   c. Nutech.
   d. Nexus.

2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Stainless steel, tamper proof, self cleaning, and removable.
4. Combination Assemblies: Include ball valve with stainless steel trim.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating: 175 psig (1207 kPa).
9. Maximum Operating Temperature: 200 deg F (93 deg C).

2.7 AIR CONTROL DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Spirotherm.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
4. Taco.
5. Metroflex.

B. Manual Air Vents (Ball Valve – Refer to Section 230523):

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2 (DN 15).
5. Discharge Connection: NPS 1/8 (DN 6).
6. CWP Rating: 150 psig (1035 kPa).
7. Maximum Operating Temperature: 225 deg F (107 deg C).

C. Automatic Air Vents (Metroflex Model MV 15A):

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.(Stainless steel, brass, EPDM).
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2 (DN 15).
5. Discharge Connection: NPS 1/4 (DN 8).
6. CWP Rating: 150 psig (1035 kPa).
7. Maximum Operating Temperature: 240 deg F (116 deg C).
8. Float Actuated- Non-Modulating High Capacity type.

D. Diaphragm-Type Expansion Tanks:

1. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Diaphragm: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

E. In-Line Air and Dirt Separators:

1. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
2. Maximum Working Pressure: Up to 175 psig (1207 kPa).
3. Maximum Operating Temperature: Up to 300 deg F (149 deg C).
4. High Efficiency, High Velocity, Coalescing Type.

2.8 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (860 kPa).

B. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig (860 kPa).

C. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch (20-mm) misalignment.
4. CWP Rating: 150 psig (1035 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

D. Double spherical, Rubber, Flexible Connectors:

1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance: Capable of misalignment.
4. CWP Rating: 150 psig (1035 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

E. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot Water Heating Piping, aboveground, NPS 2 (DN 50) and smaller, shall be any of the following:

1. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
2. Type L, drawn temper copper tubing, wrought copper fittings, and soldered joints. Use the fewest possible joints.

B. Hot Water Heating Piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be the following:

1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

C. Hot Water Heating Piping installed belowground and within slabs shall be the following:

1. Type K (A), annealed-temper soft copper tubing, wrought-copper fittings, and soldered or brazed joints. Use the fewest possible joints. Install in PVC conduit.

D. Chilled Water piping, aboveground, NPS 2 (DN 50) and smaller, shall be one of the following:

1. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
2. Type L, drawn temper copper tubing, wrought copper fittings and soldered joints. Use the fewest possible joints.

E. Chilled Water Piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be the following:

1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

F. Chilled Water Piping installed belowground and within slabs shall be the following:

1. Type K (A), annealed-temper soft copper tubing, wrought-copper fittings, and soldered or brazed joints. Use the fewest possible joints. Install in PVC conduit.

G. Makeup-water piping installed aboveground shall be the following:

1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

H. Makeup-Water Piping Installed Belowground and within Slabs: Type K (A), annealed-temper soft copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.

I. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

J. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
2. Outlet: Type K (A), annealed-temper copper tubing with soldered or flared joints.

K. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

L. Emergency Generator exhaust piping shall be the following:

1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded joints, flanged at muffler and flexible connections.

3.2 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection (serving 2 or more units) to supply mains, and at supply connection to each piece of equipment.

B. Install throttling-duty valves at each branch connection to return main.

C. Install autoflow, balancing valves in the return pipe of each heating or cooling terminal unless served by a pressure independent control (PIC) valve.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

G. Install unions at outlet connections of safety valves and automatic air vents.

H. Provide autoflow balancing valves at the end of branch piping.

I. Provide manual balancing valves in 3-way control valve bypasses. Set as same pressure drop/flow through coil.

3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the top half of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, on all sides of control valves, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere as indicated.

S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 (DN 20) nipple and ball valve in blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2 (DN 50).

T. Identify piping as specified in Division 23.

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23.

V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23.

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

X. All pipes shall be cut accurately to measurements established at the building, and shall be worked into place without springing or forcing, properly clearing all windows, doors and other openings. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted. All pipes shall be so installed as to permit free expansion and contraction without causing damage. All open ends of pipe lines, equipment, etc., shall be properly capped or plugged during installation to keep dirt or other foreign material out of the system. All pipes shall be run parallel with the lines of the building and as close to walls, columns and ceilings as may be practical, with proper pitch. All piping shall be arranged so as not to interfere with removal of other equipment on devices not to block access to doors, windows, manholes, or other access openings. Flanges or unions, as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment, coils, etc., and installed so that there will be no interference with the installation of the equipment, ducts, etc. All valves and specialties shall be placed to permit easy operation and access and all valves shall be regulated, packed and glands adjusted at the completion of the work before final acceptance. All piping shall be installed so as to avoid air or liquid pockets throughout the work. Ends of pipe shall be reamed so as to remove all burrs.

Y. All piping shall be run to provide a minimum clearance of 1/2" between finished covering on such piping and all adjacent work.

Z. All valves, strainers, caps, and other fittings shall be readily accessible.

AA. Rough-in and final connections are required to all equipment and fixtures provided under this Contract.

BB. Drain valves with hose connections shall be provided at low points for drainage of piping systems. Blow down valves shall be provided at the ends of all mains and branches so as to properly clean by blowing down the lines throughout in the direction of normal flow. Blow down valves shall be provided with cap and chain. The system shall be installed to be drained from the pump in the mechanical equipment room. Provide drain valves in all locations where water is trapped and cannot be drained at the pump location.

CC. Discharge lines from all relief valves shall be piped to within 4" of floor and extend to floor drains wherever floors are not pitched to drains.

DD. All branches from water mains shall be taken from the top of the supply mains at an angle of forty-five (45) degrees above the horizontal, unless otherwise directed. Branches feeding down shall be taken from the side or bottom of the main on water mains only. All connections shall be carefully made to insure unrestricted circulation, eliminate air pockets or trapped condensate, and permit the complete drainage of the system.

EE. Cutoff valves shall be provided on each branch line from the mains on all heating/air conditioning lines.

FF. Shut-off valves shall be installed at the inlet and outlet of each coil, control valve and piece of equipment to permit isolation for maintenance and repair. Units having multiple coils shall have separate valves for each coil.

GG. Balancing valves shall be installed in all heating/air conditioning water branches, at all pumps, where required for balancing, and where indicated on the drawings.

HH. If the size of any piping is not clearly evident in the drawings, the Contractor shall request instructions for the Engineer as to the proper sizing. Any changes resulting from the Contractor's failure to request clarification shall be at his expense. Where pipe size discrepancies exist within the drawings, the larger pipe size shall govern. Where a pipe size has not been indicated, the pipe size shall be based on a maximum of four (4) feet per 100 feet pressure drop not to exceed 10 feet per second (fps) velocity.

II. Provide automatic flow regulating valves for all heat transfer devices connected to a variable flow pumping system. Provide combination shut-off balancing valves or balancing valves with flow meter fittings for all constant volume pumping systems unless indicated otherwise. All coils and equipment with scheduled flow rates shall be provided with a balancing device.

JJ. Provide thermometers and pressure gauges at all heat transfer equipment and air handling unit coils. Provide pressure/temperature parts for all terminal heat transfer devices unless indicated otherwise.

KK. Provide chemical treatment/cleaning bypasses at all heating and cooling units.

LL. Provide air vents and drain valves for/at each coil and heat transfer equipment.

MM. Provide pressure gauges on suction and discharge of all pumps and as detailed on the drawings.

NN. Dirt pockets shall be installed at the base of all risers and as indicated on the Drawings.

OO. Install end of main automatic flow regulating bypass valves at the end of each branch line. Provide a one inch size bypass in each mechanical equipment penthouse for chilled water and heating water system.

PP. Installed dielectric water ways/fittings at connections of dissimilar metal piping and or tubing. Brass and/or bronze valves shall not be used in lieu of dielectric fittings.

QQ. Provide caps with chains for manual air vents, drain valves, and blow down valves.

RR. Provide high temperature stainless steel exhaust flexible pipe from generator to muffler. Coordinate requirements with the Electrical Contractor and emergency generator manufacturer. Provide flanged connections and externally insulate. Muffler shall be provided by the Electrical Contractor/generator manufacturer.

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m); minimum rod size, 3/8 inch (6.4 mm).
2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
4. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
5. NPS 2-1/2 (DN 65): Maximum span, 10 feet (3.4 m); minimum rod size, 3/8 inch (10 mm).
6. NPS 3 (DN 80): Maximum span, 10 feet (3.7 m); minimum rod size, 3/8 inch (10 mm).
7. NPS 4 (DN 100): Maximum span, 10 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).
8. NPS 6 (DN 150): Maximum span, 12 feet (5.2 m); minimum rod size, 1/2 inch (13 mm).
9. NPS 8 (DN 200): Maximum span, 12 feet (5.8 m); minimum rod size, 5/8 inch (16 mm).
10. NPS 10 (DN 250): Maximum span, 12 feet (6.1 m); minimum rod size, 3/4 inch (19 mm).
11. NPS 12 (DN 300): Maximum span, 12 feet (7 m); minimum rod size, 7/8 inch (22 mm).

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 3/8 inch (6.4 mm).
2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 3/8 inch (6.4 mm).
3. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
4. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
5. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
6. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).

E. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

F. Refer to structural drawings for hanger support requirements.

3.5 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at the air and dirt separator, expansion tank, and at high points of system piping in mechanical equipment rooms only. Pipe air vents to floor drains using cooper piping. For glycol systems drain to glycol tank. Manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

D. Install in-line high velocity air and dirt separators in pump suction. Install drain valve on air and dirt separators NPS 2 (DN 50) and larger.

E. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches (1200 mm) above the floor. Install feeder in minimum NPS 3/4 (DN 20) bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 (DN 20) pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.

F. Install expansion tanks on the floor unless indicated otherwise on the Drawings. Provide 18” clearance around all expansion tanks. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

G. For glycol systems pipe system drains, automatic air vents, etc. to glycol feed tank.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with ball valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.

2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION

SECTION 23 21 23 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Close-coupled, in-line centrifugal pumps.
2. Separately coupled, base-mounted, end-suction centrifugal pumps.

1.3 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

1.4 SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of hydronic pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mechanical Seals: One mechanical seal(s) for each pump.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers:
1. Bell & Gossett; Div. of ITT Industries.
2. Taco, Inc.
3. Armstrong.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically. Rate pump for 175-psig (1204-kPa) minimum working pressure and a continuous water temperature of 250 deg F (121 deg C).

C. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, and threaded companion-flange connections.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
3. Pump Shaft: Steel, with copper-alloy shaft sleeve.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.
5. Packing Seal: Stuffing box, with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
6. Pump Bearings: Permanently lubricated ball bearings.

D. Motor: Variable speed ECM type or open drip proof for constant speed type, with permanently lubricated ball bearings, unless otherwise indicated; and rigidly mounted to pump casing. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

E. Capacities and Characteristics: Refer to Drawings for Pump Capacities and Model Number.

2.3 SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

A. Manufacturers:
1. Bell & Gossett; Div. of ITT Industries.
2. Taco, Inc.
3. Armstrong.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal. Rate pump for 175-psig (1204-kPa) minimum working pressure and a continuous water temperature of 250 deg F (121 deg C).

C. Pump Construction:

1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gauge tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and threaded companion-flange connections. Provide integral mount on volute to support the casing, and attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft.
2. Impeller: ASTM B 584, cast bronze or stainless steel; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
3. Pump Shaft: Stainless Steel.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket.
5. Packing Seal: Stuffing box, with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
6. Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings.
7. Pump Shaft Sleeve: Stainless steel

D. Shaft Coupling: Molded rubber insert and interlocking spider capable of absorbing vibration. EPDM coupling sleeve for variable-speed applications.

E. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

F. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

G. Motor: Inverter duty rated, premium efficiency with AIGES shaft grounding ring for motors controlled by variable speed drives, permanently lubricated ball bearings, unless otherwise indicated; secured to mounting frame, with adjustable alignment. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

H. Capacities and Characteristics: Refer to Drawings for pump capacities and Model Number.

2.4 PUMP SPECIALTY FITTINGS

A. Suction Diffuser: Angle pattern, 175-psig (1204-kPa) pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory-fabricated support. Suction diffusers shall be system size to pump size. Suction diffusers shall be manufactured by Bell and Gossett, Taco or Armstrong.

B. Triple-Duty Valve: Angle or straight pattern, 175-psig (1204-kPa) pressure rating, cast-iron body, pump-discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features. Brass gauge ports with integral check valve, and orifice for flow measurement. Triple-Duty valve shall be full size of system piping not pump discharge connection size. Triple duty valves shall be manufactured by Bell and Gossett, Taco or Armstrong.

C. Provide pump seal flushing line and sediment filter for all pumps.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

A. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Division 23 Section "Common Work Results for HVAC."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.3 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Install continuous-thread hanger rods and spring hangers of sufficient size to support pump weight. Vibration isolation devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

E. Suspend vertically mounted, in-line centrifugal pumps independent of piping. Install pumps with motor and pump shafts vertical. Use continuous-thread hanger rods and spring hangers of sufficient size to support pump weight. Vibration isolation devices are specified in Division 21 Section "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment." Hanger and support materials are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment/Hangers and Supports for HVAC Piping and Equipment."

F. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until alignment procedure is complete.

1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches (19 to 38 mm) between pump base and foundation for grouting.
2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

G. Provide concentric increaser at pump discharge to system size as indicated on the drawings.

3.4 ALIGNMENT

A. Align (laser) pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation.

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.5 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install triple-duty valve on discharge side of pumps.

F. Install suction diffuser and shutoff valve on suction side of pumps.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

H. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve.

I. Install check valve and ball valve on each condensate pump unit discharge.

J. Install electrical connections for power, controls, and devices.

K. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

L. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:

   a. Verify bearing lubrication.
   b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
   c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-454B or R-32:

1. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
2. Suction Lines for Heat-Pump Applications: 535 psig (3689 kPa).
3. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

1.4 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:

1. Thermostatic expansion valves.
2. Solenoid valves.
3. Hot-gas bypass valves.
4. Filter dryers.
5. Strainers.
6. Pressure-regulating valves.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Shop Drawing Scale: 3/8 inch equals 1 foot.
2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

C. Welding certificates.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

F. All refrigerant piping system is a delegated design. All piping, sizes, routing, traps, vibration isolators, service valves, piping accessories etc. shall be a delegated design coordinated with the equipment manufacturer.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.6 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.7 COORDINATION

A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. Refer to Details on the Drawings.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Brazing Filler Metals: AWS A5.8.

E. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch-(180-mm-) long assembly.
4. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

2.2 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.

4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 275 deg F (135 deg C).

B. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig (3450 kPa).
8. Maximum Operating Temperature: 275 deg F (135 deg C).

C. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
8. Working Pressure Rating: 500 psig (3450 kPa).
9. Maximum Operating Temperature: 275 deg F (135 deg C).

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig (3450 kPa).

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and 24-V ac coil.
6. Working Pressure Rating: 400 psig (2760 kPa).
7. Maximum Operating Temperature: 240 deg F (116 deg C).
8. Manual operator.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig (2760 kPa).
6. Maximum Operating Temperature: 240 deg F (116 deg C).

G. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F (4.4 deg C).
6. Superheat: Adjustable.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 700 psig (4820 kPa).

H. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.

1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
5. Seat: Polytetrafluoroethylene.
6. Equalizer: Internal or External.
7. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and 24-V ac coil.
8. End Connections: Socket.
9. Set Pressure: As required or recommended by the equipment manufacturer.
10. Throttling Range: Maximum 5 psig (34 kPa).
11. Working Pressure Rating: 500 psig (3450 kPa).
12. Maximum Operating Temperature: 240 deg F (116 deg C).

I. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig (3450 kPa).
5. Maximum Operating Temperature: 275 deg F (135 deg C).

J. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig (3450 kPa).
6. Maximum Operating Temperature: 275 deg F (135 deg C).

K. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 240 deg F (116 deg C).

L. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina or charcoal, as recommended by the equipment manufacturer.
4. Designed for reverse flow (for heat-pump applications).

5. End Connections: Socket.
6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig (14 kPa).
8. Rated Flow: Refer to Drawings and Equipment Characteristics.
9. Working Pressure Rating: 500 psig (3450 kPa).
10. Maximum Operating Temperature: 240 deg F (116 deg C).

M. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina or charcoal, as recommended by the equipment manufacturer.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig (14 kPa).
8. Rated Flow: Refer to Drawings and Equipment Characteristics.
9. Working Pressure Rating: 500 psig (3450 kPa).
10. Maximum Operating Temperature: 240 deg F (116 deg C).

N. Mufflers:

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or flare.
3. Working Pressure Rating: 500 psig (3450 kPa).
4. Maximum Operating Temperature: 275 deg F (135 deg C).

O. Receivers: Comply with ARI 495.

1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
2. Comply with UL 207; listed and labeled by an NRTL.
3. Body: Welded steel with corrosion-resistant coating.
4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
5. End Connections: Socket or threaded.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 275 deg F (135 deg C).

P. Liquid Accumulators: Comply with ARI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig (3450 kPa).
4. Maximum Operating Temperature: 275 deg F (135 deg C).

2.3 REFRIGERANTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

C. ASHRAE 34, R-454B or R-32: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-454B or R-32

A. Suction Lines NPS 1-1/2 (DN 40) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

B. Suction Lines NPS 4 (DN 100) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

C. Hot-Gas and Liquid Lines:

1. NPS 1 (DN 25) and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
2. NPS 4 (DN 100) and smaller: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

D. Safety-Relief-Valve Discharge Piping: Schedule 40, black-steel and wrought-steel fittings with welded joints.

E. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

F. Safety-Relief-Valve Discharge Piping:
1. NPS 4 (DN 100): Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

E. Install a full-sized, three-valve bypass around filter dryers.

F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

G. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Hot-gas bypass valves.
4. Compressor.

K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

L. Install receivers sized to accommodate pump-down charge.

M. Install flexible connectors at compressors and equipment (condensers, compressors etc).

N. Install shut off valves for each piping circuit at the chiller and condensing unit to isolate equipment at the source, at strainers, dryers and items that require service and or replacement to minimize loss of refrigerant

3.3 PIPING INSTALLATION

A. Refrigerant piping system is a delegated design. All piping, valves, accessories, etc. shall be installed, reviewed, and approved by the equipment manufacturer to maintain the equipment warranty. The equipment manufacturer shall be required to inspect all piping and provide documentation on company letterhead that the installation complies with the manufacturers' recommendations, and the manufacturer shall warranty the equipment. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls" for solenoid valve controllers, control wiring, and sequence of operation.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in

Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Install refrigerant piping in protective conduit where installed belowground.

N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

O. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

P. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

R. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

V. Install all piping and accessories in accordance with the manufacturers recommendations.

3.4 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

E. Threaded Joints: Thread steel pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers with neoprene inserts and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod size, 3/8 inch (6.4 mm).
2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod size, 3/8 inch (6.4 mm).
3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod size, 3/8 inch (6.4 mm).
4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
6. NPS 2 (DN 50): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
7. NPS 2-1/2 (DN 65): Maximum span, 108 inches (2700 mm); minimum rod size, 3/8 inch (9.5 mm).
8. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (9.5 mm).
9. NPS 4 (DN 100): Maximum span, 12 feet (3.7 m); minimum rod size, 1/2 inch (13 mm).

D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

   a. Fill system with nitrogen to the required test pressure.
   b. System shall maintain test pressure at the manifold gage throughout duration of test.
   c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
   d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.

2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
1. Verify that compressor oil level is correct.
2. Open compressor suction and discharge valves.
3. Open refrigerant valves except bypass valves that are used for other purposes.
4. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 23 25 00 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following HVAC water-treatment systems:

1. HVAC water-treatment chemicals.

1.3 DEFINITIONS

A. EEPROM: Electrically erasable, programmable read-only memory.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

C. RO: Reverse osmosis.

D. TDS: Total dissolved solids.

E. UV: Ultraviolet.

1.4 PERFORMANCE REQUIREMENTS

A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.

B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

C. Closed hydronic systems, including hot-water heating and chilled water, shall have the following water qualities:

1. pH: Maintain a value within 9.0 to 10.5.
2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
3. Boron: Maintain a value within 100 to 200 ppm.
4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
6. TDS: Maintain a maximum value of 10 ppm.
7. Ammonia: Maintain a maximum value of 20 ppm.
8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
9. Microbiological Limits:

   a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
   b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.
   c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.

d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

1.5 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:

1. Bypass feeders.
2. Water meters.
3. Chemical test equipment.
4. Chemical material safety data sheets.
5. Glycol feeders.

B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: Power and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in emergency, operation, and maintenance manuals.

E. Other Informational Submittals:

1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
2. Water Analysis: Illustrate water quality available at Project site.
3. Passivation Confirmation Report: Verify passivation of galvanized-steel surfaces, and confirm this observation in a letter to Architect.

1.6 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 MAINTENANCE SERVICE

A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for cooling, chilled-water piping and heating, hot-water piping and equipment. Services and chemicals shall be provided for a period of two (2) years from date of Substantial Completion, and shall include the following:

1. Initial water analysis and HVAC water-treatment recommendations.
2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
3. Monthly field service and consultation.
4. Customer report charts and log sheets.
5. Laboratory technical analysis.

6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

PART 2 - PRODUCTS

2.1 WATER TREATMENT SERVICES

A. Complete chemical water treatment service shall be provided by Proasys or equal. The service shall provide all equipment, chemicals and labor necessary to prevent corrosion, inhibit scale build-up and minimize organic growth for a period of two (2) years starting from substantial completion. Service visits for the purpose of adding chemicals to feeding equipment, regulating bleed-off, inspecting and adjusting water treatment equipment, and obtaining and analyzing samples at monthly intervals in order to maintain conditions as specified below during the entire guarantee period. Obtain a signed service card after each visit and leave a report indicating which systems were serviced. Chemicals shall not be injurious to water side equipment and construction materials. Records of all service visits, chemical additions, laboratory tests, etc., shall be maintained and shall be delivered to the Owner after each visit during the guarantee period. Instruct the Mechanical Contractor in field of piping and wiring of the chemical feeding equipment.

B. Systems to be protected shall include the heating water, and chilled water systems. Services shall include flushing and cleaning of piping systems, furnishing and installing all chemical treatment equipment and accessories to perform the water treatment.

C. Contractor shall perform an analysis of the building water supply as a basis of the chemical treatment. Contractor shall provide the Owner with written instructions for chemical feeding bleed-off, blowdown control and testing procedures, provide all required chemicals during the guarantee period, and provide all required test kits.

D. Before adding cleaning chemical to the closed system, all air handling unit coils, terminal heating coils and miscellaneous heating and cooling equipment shall be isolated by closing the inlet and outlet valves and opening the bypass valves. This is done to prevent dirt and solids form lodging in the coils.

E. Closed Recirculating Systems shall be filled and sufficient detergent and dispersant added to remove all dirt, oil, and grease. System shall be circulated for 8 hours after which a drain valve at the lowest point shall be opened and allowed to bleed while the system continues to circulate. The automatic make-up valve shall be checked to be sure it is operating. Bleeding shall continue until water runs clear and all detergent is removed. A sample of water shall be tested and if pH exceeds the pH of the make-up water, flushing shall be resumed.

F. After chemical cleaning is satisfactorily completed, open the inlet and outlet valves to each coil and close the bypass valves. Also, clean all strainers.

2.2 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.

B. Polypropylene Glycol

1. Provide a 35% by volume propylene glycol solution to the primary (chiller) chilled water system and heating water system (the industrial grade inhibited propylene glycol heat transfer fluid as manufactured by the Dow Chemical Company (Dowfrost HD), or as approved equal. The propylene glycol solution as supplied by the manufacturer shall contain corrosion inhibitors specially formulated for cool storage services to keep internal surfaces free from corrosion and fouling and shall include buffers, reserve alkalinity agents, antifoaming additives, and a fluorescent dye to aid in leak detection. The solution shall be easily reinhibited using specially formulated inhibitor readily available from the field manufacturer. The manufacturer shall provide free propylene glycol yearly

solution laboratory analysis. The analysis shall accurately report propylene glycol concentration, freezepoint temperature, inhibitor level, alkalinity, particulate and recommended additions of glycol, inhibitor and buffers to ensure twenty-year minimum life. The fluid shall pass the ASTM D-1384 test with less than 0.5 mils penetration per year.

2. Automotive antifreeze or any solutions containing silicates will not be acceptable.
3. Propylene glycol shall be supplied prediluted with deionized water.
4. Provide a Misco Products calibrated hand-held refractormeter.
5. Provide one spare 55 plastic drum of glycol.

2.3 CHEMICAL TREATMENT

A. Delete this Article if chemical-treatment systems are specified in Division 23 Section "HVAC Water Treatment."

B. Bypass Chemical Feeder: Welded steel construction; 125-psig (860-kPa) working pressure; 5-gal. (19-L) capacity; with fill funnel and inlet, outlet, and drain valves.

1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

C. Glycol Feedwater System: Provide a packaged, duplex automatic glycol solution make up unit model GMPD as manufactured by Wessels or approved equal. The unit shall serve two independent systems, heating system and cooling system. The system shall include two autonomous pumping system assemblies. Each pump shall be 1/3 HP. The package shall consist of a base, 50 gallon polyethylene reservoir with removable lid and visible solution level scale in gallons and liters, y-strainer, isolation valve, two pumps, open drip-proof motor, pump isolation, check and balance valve, expansion tank, discharge pressure gage, motor contactor, pressure control and necessary interconnecting piping. Pump shall start based on falling pressure. Greenlight shall indicate power supplied to unit. System shall require two (2) independent 115/1/60 power connection and a ¾" NPT system piping connection. GMPD shall provide 1.8 GPM at 70 PSI and maintain a fill pressure of 30 PSI. Unit includes low level cutout, with red indicator light and 110V contact for alarm indication, to stop the pump during lower level condition. Contractor shall furnish application specific pressure reducing valve between GMPD and connection to the system piping.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.

B. Install water testing equipment on wall near water chemical application equipment.

C. Install interconnecting control wiring for chemical treatment controls and sensors.

D. Mount sensors and injectors in piping circuits.

E. Bypass Feeders: To introduce additional inhibitors, provide in closed hydronic systems, including hot-water heating, chilled water, and equipped with the following:

1. Install bypass feeder in a bypass circuit around circulating pumps, unless otherwise indicated on Drawings. Bypass feeder is existing to remain.
2. Install water meter in makeup water supply. Water meter is existing to remain.
3. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
4. Install full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
5. Install a swing check on inlet after the isolation valve.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Division 23 Section "Common Work Results for HVAC."

D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Division 23 Section "General-Duty Valves for HVAC Piping."

E. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers required in makeup water connections to potable-water systems.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
7. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
8. Repair leaks and defects with new materials and retest piping until no leaks exist.

D. Remove and replace malfunctioning units and retest as specified above.

E. Sample boiler water at one-week intervals after boiler startup for a period of five weeks, and prepare test report advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article for each required characteristic. Sample boiler water at four-week intervals following the testing noted above to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section.

F. At four-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.

G. Comply with ASTM D 3370 and with the following standards:

1. Silica: ASTM D 859.
2. Steam System: ASTM D 1066.
3. Acidity and Alkalinity: ASTM D 1067.
4. Iron: ASTM D 1068.
5. Water Hardness: ASTM D 1126.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

END OF SECTION

SECTION 23 31 13 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings. Rectangular double wall ducts and fittings.
2. Single-wall round and flat oval ducts and fittings.
3. Double-wall round and flat oval ducts and fittings.
4. Sheet metal materials.
5. Duct liner.
6. Sealants and gaskets.
7. Hangers and supports.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in the latest ASHRAE 62 Standard.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculation, for selecting hangers and supports.

D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.
   f. Perimeter moldings.

E. Welding certificates.

F. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports; AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports; AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. All kitchen hood, range hood exhaust ducts shall be 18 gauge minimum, type 304 stainless steel with welded joints and comply with NFPA 96.

F. Minimum duct gauge shall be 22 ga.

2.2 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal:

1. McGill AirFlow LLC.
2. Lindab.
3. Semco.
4. Eastern Sheet Metal.

B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

G. Inner Duct: Minimum 0.028-inch (0.7-mm) perforated galvanized sheet steel having 3/32-inch- (2.4-mm-) diameter perforations, with overall open area of 23 percent, unless otherwise noted to have solid sheet steel.

H. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Traverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

I. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

J. Provide 20 gauge minimum duct construction for the first twenty (20) feet supply and return/relief ducts connected to air handling units (AHU’s, ERVs, DOAS units) unless noted otherwise. This ductwork shall be internally lined provided perforated inner galvanized liner covering (i.e. Double Wall). Refer to Drawings for additional information.

K. Minimum duct gauge shall be 22 ga.

2.3 SINGLE-WALL ROUND AND FLAT OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal:

   a. Lindab Inc.
   b. McGill AirFlow LLC.
   c. SEMCO Incorporated.
   d. Eastern Sheet Metal.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. All round ductwork shall be spiral type, 22 ga. minimum. Snap lock longitudinal joints are prohibited.

G. All fittings shall be fully welded type. Adjustable elbows are prohibited. Only use fittings as detailed on the Drawings. Straight tees and laterals are prohibited. Ninety-degree mitered elbows, bull head tees, and saddle taps are prohibited.

H. Exposed ductwork shall be paint grade.

2.4 DOUBLE-WALL ROUND DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal:

1. Lindab Inc.
2. McGill AirFlow LLC.
3. SEMCO Incorporated.
4. Eastern Sheet Metal.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

   a. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

   a. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
   b. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Inner Duct: Minimum 0.028-inch (0.7-mm) perforated galvanized sheet steel.

E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

F. All round ductwork shall be spiral type, 22 ga minimum.

G. All fittings shall be fully welded type. Only use fittings as detailed on the Drawings. Straight tees and laterals are prohibited. Ninety-degree mitered elbows, bull head tees, and saddle taps are prohibited.

H. Joints: Ductwork exposed in finished occupied areas shall utilize “O” ring type joints.

I. Paint grade ductwork shall be utilized where exposed ductwork is located in finished areas.

2.5 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Provide 20 gauge minimum duct construction for the first twenty (20) feet supply and return ducts connected to roof-mounted air handling units, DOAS units, and ERV units. This ductwork shall be internally lined provided with perforated inner galvanized liner covering.

C. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90 (Z275).
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

E. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.6 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by Owens Corning or one of the following:

a. CertainTeed Corporation; Insulation Group.
b. Johns Manville.

c. Knauf Insulation.
d. Owens Corning.

2. Maximum Thermal Conductivity:

a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F (0.033 W/m x K) at 75 deg F (24 deg C) mean temperature.

3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
4. Solvent-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick aluminum; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s).
7. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

a. Fan discharges.
b. Intervals of lined duct preceding unlined duct.
c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm (12.7 m/s) or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.7 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches (102 mm).
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.8 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.9 OPEN END DUCTS (OED)

A. Whether indicated on plans or not, all open-ended ducts shall be provided with a protetive screen.

B. All open-ended ducts shall be furnished with a heavy gauge aluminum ½”x½” bird screen. Screens shall be permanently installed in a removable frame, and the frame shall be attached to the open-ended duct in a neat, workmanship-like manner without any exposed edges or sharp surfaces.

C. Screen shall be attached to a 3/4-inch x 1/8-inch continuous galvanized perimeter frame. Install duct stiffeners greater than 16 inches in any direction at open-ended ducts.

D. Terminate open end ducts above occupied area’s cut on a 45 angle open to top.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

M. All ductwork shall be shipped and stored with ends and openings sealed. All open ducts shall be sealed at the end of each work day.

N. Use radius type elbows wherever possible. Use 90° elbows with turning vane where radius elbows cannot be used.

O. Only use fitting types as detailed on the drawings. Only use conical style in lieu of straight type. Use laterals in lieu of TEEs. Bull Head TEE’s, Saddle Taps, Round Mitered 90° elbows are prohibited from use.

P. Coordinate locations of double wall and single wall ductwork with the insulator sub-contractor. All outdoor air, supply air, makeup air, return air, and relief air ductwork requires insulation.

Q. All ductwork located in attic spaces shall be double wall type and externally insulated.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system. Round exposed ducts shall utilize joint o-ring seals and use cable hangers.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

F. Exposed ductwork (including cloud ceilings) shall be double wall type with paint grid finish.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet (6 m) in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches (38 mm) from bottom of duct.

C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

D. Comply with NFPA 96 requirements and the authority having jurisdiction.

3.4 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." All ducts shall be completely sealed, except for round exposed ducts in finished spaces, which shall utilize joint o-ring seals.

B. All ducts shall be sealed. As a minimum, seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class A.
4. Outdoor, Return-Air Ducts: Seal Class A.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class A.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class A.
8. Unconditioned Space, Return-Air Ducts: Seal Class A.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class B.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

D. Hangers Exposed to View: Provide cable type hangers for ductwork located in finished occupied spaces.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

G. Cable hangers are prohibited except for exposed ductwork located in finished occupied spaces.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have exposed duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

B. Where indicated on the architectural drawings, all exposed ductwork (including cloud ceiling systems) shall be primed and painted. Utilize paint grade galvanized ductwork. Coordinate requirements with the general trades contractor.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

a. Ducts with a Pressure Class Higher Than 3-Inch wg (750 Pa): Test representative duct sections, totaling no less than 100 percent of total installed duct area for each designated pressure class.
b. Supply Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections, totaling no less than 100 percent of total installed duct area for each designated pressure class.
c. Return Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections, totaling no less than 100 percent of total installed duct area for each designated pressure class.
d. Exhaust Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections, totaling no less than 100 percent of total installed duct area for each designated pressure class.
e. Outdoor Air Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections, totaling no less than 100 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give five days' advance notice for testing.
7. All duct testing shall be witnessed by the Testing and Balancing Company, and by the Owner's Representative.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:

1. Ducts Connected to Terminal Units: Cabinet unit heaters, etc.:

a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Indoor Air Handling Units (including ERV and DOAS units):

a. Pressure Class: Positive 2-inch wg.

b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12.
e. Provide 20 gauge minimum double wall construction for the first twenty (20) feet of suction and discharge air ductwork connected to the air handling units, ERV units and DOAS units.
f. Supply ducts include conditioned outside air ducts from ERV and DOAS units.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

C. Return/Relief Ducts:

1. Ducts Connected to Terminal Units: Cabinet unit heaters, etc.:

a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Indoor Air Handling Units (including ERV and DOAS units):

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12.
e. Provide 20 gauge minimum duct construction for the first twenty (20) feet of suction and discharge ducts (relief/exhaust) connected to air handling units, ERV units and DOAS units.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12.
e. Provide 20 gauge minimum and 1” thick double wall ductwork for ten (10) feet on the inlet and outlet of each indoor in-line (centrifugal or mixed flow) fan.

2. Ducts Connected to Range Hoods and Commercial Kitchen Hoods: Comply with NFPA 96.

a. Exposed to View: Type 304, 18 gauge minimum, stainless-steel sheet, No. 4 finish.
b. Concealed: Type 304, 18 gauge minimum, stainless-steel sheet, No. 2D finish.
c. Welded seams and joints.
d. Pressure Class: Positive or negative 3-inch wg.
e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
f. SMACNA Leakage Class: 3.
g. Provide all approved duct cleanout/access doors as required by NFPA 96.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

4. Ducts Connected to Clothes Dryer (Round Aluminum Vent Ductwork):

    a. Aluminum Ducts: ASTM B209. Aluminum sheet, alloy 3003-H14. Aluminum connectors and band stock: Alloy 6061-T6 or of equivalent strength. At the contractors option dryer ducts can be stainless steel.
    b. Dryer vent round ductwork shall be 20 gauge (minimum) aluminum construction with die-stamped or fabricated fittings. Ducts shall be constructed for low pressure operation with longitudinal seam up. Provide cleanouts at all changes in direction exceeding 45 degrees.
    c. Fabricated elbows shall be the multi-piece type with each segment not exceeding 22-1/2 degrees. Throat radius of all elbows shall be equal to the duct diameter. Tees shall be the concealed type.
    d. Joints shall be the slip or flanged type. Do not use drive slip coupling bands. Make-up slip joints with duct sealer.
    e. Ducts for exhausting clothes dryers shall not be assembled with screws or other fastening means that extend into the duct and that would catch lint.
    f. Provide NFPA 90A approved flexible duct section at connection of dryer to ductwork.
    g. Dryer vents shall terminate with a stainless steel wall cap with integral gravity backdraft damper.
    h. Where clothes dryer vent ducts pass through walls, floors, or partitions, the space around the duct shall be sealed with non-combustible material and firestopped.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Terminal Units (Fan Coil Units, etc.):

    a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 24.
    d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Air-Handling Units (including ERV and DOAS units):

    a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 24.
    d. SMACNA Leakage Class for Round and Flat Oval: 12.

3. Ducts Connected to Equipment Not Listed Above:

    a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
    b. Minimum SMACNA Seal Class: A.
    c. SMACNA Leakage Class for Rectangular: 24.
    d. SMACNA Leakage Class for Round and Flat Oval: 12.

F. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

2. Stainless-Steel Ducts:

    a. Exposed to Airstream: Match duct material.
    b. Not Exposed to Airstream: Match duct material.

3. Aluminum Ducts: Aluminum.

G. Single Wall Duct Interstitial Insulation:

1. Transfer Air Ducts: Fibrous glass, Type I, 1 inch (25 mm) thick
2. Supply Air Diffuser Plenum: Fibrous glass, Type I, 1 inch (25 mm) thick for supply air terminal device plenum boxes (ceiling diffusers, linear slot diffusers, etc.)

H. Double-Wall Duct Interstitial Insulation:

1. Double wall lined ductwork shall be installed in exposed finished areas and for the first twenty (20) feet of suction and discharge air ductwork from the air handling units (including ERV and DOAS units) and twenty (20) feet on the suction and discharge of remote in-line type return/relief/exhaust fans unless indicated otherwise and to the extent shown on the drawings. Liner shall be fibrous glass, type 1, 1 inch thick with inner perforated metal liner.
2. Round exposed ductwork shall be paintable galvanized steel, double wall construction with perforated interior liner and self-sealing “O” ring duct connectors, similar to Lindab (Flanges are prohibited).
3. All lined ductwork shall be fibrous glass, type 1, 1 inch thick with perforated galvanized inner liner (i.e. double wall).
4. All exterior ductwork and ductwork located in the attic space shall be double wall.
5. All air handling units (including ERV and DOAS units) supply and return air ductwork shall be double wall with 1” liner and perforated galvanized inner liner except for round runouts to diffusers.

I. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
   a. Velocity 1000 fpm (5 m/s) or Lower:
      1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      2) Mitered Type RE 4 without vanes.
   b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):
      1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with air foil vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
   c. Velocity 1500 fpm (7.6 m/s) or Higher:
      1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with air foil vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with air foil type vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      4) Radius-to Diameter Ratio: 1.5.
   b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Standing seam.

d. Only round duct fittings indicated on the drawings shall be used. Bull head tee's, saddle taps, mitered elbows, etc. are prohibited.
e. Round ductwork shall be spiral type with fully welded elbows.

J. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."

   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Spin in, 45 degree rectangular to round.
   c. Provide manual volume dampers with insulation stand off as close to main duct as possible when serving registers, diffusers, and grilles.
   d. Refer to Drawing Details.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees.". Provide only fittings detailed on the Drawings. All other fittings are prohibited.

   a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree conical tap.
   b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Lo Loss fitting or 45-degree conical lateral.
   c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree conical lateral (or Lo Loss fitting where indicated on the Drawings).
   d. Refer to Drawing Details.

END OF SECTION

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Manual volume dampers.
2. Control dampers.
3. Fire dampers.
4. Smoke dampers.
5. Combination fire and smoke dampers.
6. Corridor dampers.
7. Flange connectors.
8. Duct silencers.
9. Turning vanes.
10. Remote damper operators.
11. Duct-mounted access doors.
12. Flexible connectors.
13. Flexible ducts.
14. Duct accessory hardware.

B. Related Sections:

1. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
2. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control damper installations.
d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Wiring Diagrams: For power, signal, and control wiring.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

D. Source quality-control reports.

E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

1.5 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 (Z180).
2. Exposed-Surface Finish: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.

D. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide Ruskin MD-35 (Rectangular), Ruskin MDRS25 (Round), or comparable product by one of the following:
    a. Air Balance Inc.; a division of Mestek, Inc.
    b. American Warming and Ventilating; a division of Mestek, Inc.
    c. METALAIRE, Inc.
    d. Pottorff
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications with velocities to 1500 feet per minute and 3 inches w.g.
4. Frames:
    a. Hat-shaped, galvanized-steel channels, 0.064-inch (1.62-mm) minimum thickness.
    b. Mitered and welded corners.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.
    d. Two-inch insulation stand-off bracket with extended shaft rod.
    e. Hand Quadrant.
5. Blades:
    a. Multiple or single blade with blade stop.
    b. Opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Galvanized-steel, 0.064 inch (1.62 mm) thick.
    e. Six-inche nominal width.
6. Blade Axles: Galvanized steel. Hex-shaped, mechanically attached to blade, minimum 1/2" diameter.
7. Bearings:
    a. Oil-impregnated bronze iolite bearings.
    b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Galvanized steel.
9. Provide 45 degree take off, rectangular to round with integral damper to diffusers.

B. Standard, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide Ruskin MD-35 or comparable product by one of the following:
    a. Air Balance Inc.; a division of Mestek, Inc.
    b. American Warming and Ventilating; a division of Mestek, Inc.
    c. McGill AirFlow LLC.
    d. METALAIRE, Inc.
    e. Pottorff
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch- (2.5-mm-) thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts. Two-inch insulation stand-off bracket with extended shaft rod and hand quadrant.
5. Blades:
    a. Multiple or single blade with blade stop.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. Roll-Formed Aluminum Blades: 0.10-inch- (2.5-mm-) thick aluminum sheet.
    e. Extruded-Aluminum Blades: 0.050-inch- (1.2-mm-) thick extruded aluminum.
6. Blade Axles: Minimum 1/2-inch diameter stainless steel.
7. Bearings:
    a. Oil-impregnated bronze, oillite bearings.

b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Aluminum.

2.3 CONTROL DAMPERS (LOW LEAK)

A. Manufacturers: Subject to compliance with requirements, provide Ruskin CD60 or products by one of the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. METALAIRE, Inc.
5. Ruskin Company.
6. Pottorff

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage. Leakage shall be less than 3 cfm/square foot at 1-inch static pressure/less than 8 cfm/square foot at 4 inches of static pressure, and is AMCA-Certified as a Class 1A damper.

C. Frames:

1. 5” x 1” x 16 gauge hat channel shaped reinforced with corner braces.
2. Galvanized -steel channels, 0.064 inch (1.62 mm) thick.
3. Mitered and welded corners.
4. Round, oval and rectangular duct transition connections shall be welded for high pressure.

D. Blades:

1. Multiple blade with maximum blade width of 8 inches by 6 inches high.
2. Parallel (2 position) and Opposed-blade (modulating) design.
3. Galvanized or stainless steel.
4. Double skin, airfoil type 14 gauge equivalent thickness.
5. Blade Edging: Neoprene blade edge seals and flexible metal compressible jamb seals.

E. Blade Axles: 1/2-inch- (13-mm-) hexagonal positively locked into the damper blade; galvanized or stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings. Removable control shaft shall extend 6-inches beyond frame.

1. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).

F. Bearings:

1. Permanently lubricated, corrosion-resistant stainless-steel sleeve.
2. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.4 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide Ruskin DIBD2 (Standard), FD60 (Multi-blade), FD 35/OW (Out of wall/floor) or products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Greenheck Fan Corporation.

4. Prefco; Perfect Air Control, Inc.
5. Pottorff

B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL, Leakage Class A.

C. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 2000-fpm (10-m/s) velocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch (1.3 or 3.5 mm) thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Airfoil shaped, double skin, single piece construction with 14 gauge equivalent thickness, maximum 6” wide.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.

K. Damper Style: “B” style for low pressure rectangular; “BC” style welded for medium pressure rectangular; “WR” style, welded for round transition applications; and “WO” style, welded for flat oval transition applications.

L. Provide grille type fire dampers for supply and return air grilles located in the two-hour fire wall serving the main entrance.

2.5 SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide Ruskin SD 60 or products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. Pottorff

B. General Requirements: Label according to UL 555S by an NRTL, Classified Class 1.

C. Smoke Detector: Integral, factory wired for single-point connection, no or low air flow type.

D. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners. Round, oval and rectangular transition connections shall be one-piece airfoil, 6-inches wide and 16 gauge; welded type (WR, WD and WC).

E. Blades: Galvanized sheet steel blade seals, silicone edge type, mechanically fastened to the blade edge for smoke seal to 450 deg F. Jamb seals shall be stainless steel, flexible metal compression type. Bearings shall be stainless steel sleeve type, pressed into frame.

F. Leakage: Class I.

G. Rated pressure and velocity to exceed design airflow conditions.

H. Mounting Sleeve: Factory-installed, 0.052-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application.

I. Damper Motors: Modulating or two-position action. Refer to Sequence of Operation on the Drawings.

J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section "Instrumentation and Control for HVAC" and Division 26 Sections**.**
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
7. Electrical Connection: 24 V, single phase, 60 Hz. Coordinate requirements with Divisions 23 and 26.

K. Accessories:

1. Auxiliary damper position indicator, remote mounted in ceiling
2. Test and reset switches, remote mounted in ceiling
3. Remote accessories shall be MS Series by Space Age Electronics or equal.

2.6 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide Ruskin FSD 60 or products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. Pottorff

B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL, Leakage Class I.

C. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 4000-fpm (20-m/s) velocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Jamb Seals: Stainless steel, flexible metal compression type.

F. Heat-Responsive Device: Electric resettable fuse link and switch package, factory installed, 165 deg F rated.

G. Smoke Detector: Integral, factory wired for single-point connection.

H. Frame: 5” x 16 gauge galvanized hat-shaped channel. No flow rated. Multiple-blade type. Round, oval and rectangular duct transition connections shall be welded for high pressure.

I. Blades: Air-foil shaped, double skin, single piece construction with 14 gauge equivalent thickness, maximum 6” wide. Blade edge seals shall be silicone edge type for smoke seal up to 450 deg F and galvanized steel for frame seal to 1900 deg F.

J. Leakage: Class I.

K. Rated pressure and velocity to exceed design airflow conditions.

L. Mounting Sleeve: Factory-installed, 0.052-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application.

M. Master control panel for use in dynamic smoke-management systems.

N. Damper Motors: Modulating or two-position action. Refer to Sequence of Operation on the Drawings.

O. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section "Instrumentation and Control for HVAC" and Division 26 Sections**.**
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
7. Electrical Connection: 24 V, single phase, 60 Hz.

P. Accessories:

1. Auxiliary damper position indicator, remote mounted in ceiling.
2. Test and reset switches, remote mounted in ceiling
3. Remote accessories shall be MS Series by Space Age Electronics or equal.

2.7 CORRIDOR DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide Ruskin FSD 60C or products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Nailor Industries Inc.
4. Pottorff

B. General Requirements: Label combination fire and smoke dampers according to UL 555 for 1-1/2-hour rating by an NRTL, Class 1.

C. Heat-Responsive Device: 165 deg F, electric resettable fuse link and switch package, factory installed, no flow rated duct detector.

D. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.

E. Blades: Airfoil shaped, double skin, single piece construction with 14 gauge equivalent thickness, maximum 6-inches wide. Blade seals shall be silicone edge type for smoke seal to 450 deg F and galvanized steel for frame seal to 1900 deg F. Bearings shall have stainless steel sleeve pressed into frame. Jamb seals shall be stainless steel, flexible metal compression type..

F. Mounting Sleeve: Factory-installed, 0.052-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application.

G. Damper Motors: Modulating or two-position action. Refer to Sequence of Operation on the Drawings.

H. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section "Instrumentation and Control for HVAC" and Division 26 Sections.
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
7. Electrical Connection: 24 V, single phase, 60 Hz.

2.8 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gauge and Shape: Match connecting ductwork.

2.9 DUCT SILENCERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Price Industries or comparable product by one of the following:

1. IAC.
2. Vibro-Acoustics.

B. General Requirements:

1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

C. Shape:

1. Rectangular straight with splitters or baffles.
2. Round straight with center bodies or pods.
3. Rectangular elbow with splitters or baffles.
4. Round elbow with center bodies or pods.
5. Rectangular transitional with splitters or baffles.

D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90 (Z275), galvanized sheet steel, 22 gauge thick.

E. Round Silencer Outer Casing: ASTM A 653/A 653M, G90 (Z275), galvanized sheet steel.

1. Sheet Metal Thickness for Units up to 24 Inches (600 mm) in Diameter: 0.034 inch (0.85 mm) thick.
2. Sheet Metal Thickness for Units 26 through 40 Inches (660 through 1000 mm) in Diameter: 0.040 inch (1.02 mm) thick.
3. Sheet Metal Thickness for Units 42 through 52 Inches (1060 through 1300 mm) in Diameter: 0.052 inch (1.3 mm) thick.
4. Sheet Metal Thickness for Units 54 through 60 Inches (1370 through 1500 mm) in Diameter: 0.064 inch (1.62 mm) thick.

F. Inner Casing and Baffles: ASTM A 653/A 653M, G90 (Z275) galvanized sheet metal, 16 gauge thick, and with 1/8-inch- (3-mm-) diameter perforations.

G. Special Construction:

1. Suitable for outdoor use.
2. High transmission loss.
3. Stainless steel construction when installed in stainless steel ductwork.

H. Connection Sizes: Match connecting ductwork unless otherwise indicated.

I. Principal Sound-Absorbing Mechanism:

1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
2. Dissipative type with fill material.
   a. Fill Material: Inert, vermin-proof and moisture-proof fibrous material, packed under not less than 5 percent compression.
   b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.
3. Lining: None.

J. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.

1. Lock form and seal or continuously weld joints.

2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
3. Reinforcement: Cross or trapeze angles for rigid suspension.
4. Fume Hood Silencer shall be constructed of stainless steel, fully welded construction. Silencer shall attenuate air transmitted noise by controlled impedance membranes and broadly tuned resonators.

K. Accessories:
1. Factory-installed end caps to prevent contamination during shipping.

L. Source Quality Control: Test according to ASTM E 477.
1. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000-fpm (10-m/s) face velocity.
2. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg (1500-Pa) static pressure, whichever is greater.

M. Capacities and Characteristics:

1. Configuration: Straight.
2. Shape: Rectangular and round.
3. Attenuation Mechanism: Acoustical glass fiber. Helmholtz resonator mechanism with no internal media.
4. Maximum Pressure Drop: Refer to Drawings.
5. Casing:

   a. Attenuation: Standard.
   b. Outer Material: Galvanized steel or stainless steel based on duct system construction.
   c. Inner Material: Galvanized steel or stainless steel based on duct system construction.

6. **V**elocity Range.
7. End Connection: 1-in (25-mm) slip joint for flange.
8. Length: Refer to Drawings.
9. Face Dimension: Refer to Drawings.
10. Face Velocity: Refer to Drawings.
11. Dynamic Insertion Loss: Refer to Drawings.
12. Generated Noise: Refer to Drawings.
13. Accessories: None.

2.10 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. SEMCO Incorporated.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

D. Vane Construction: Single and Double wall.

E. Vane Construction: Single wall for ducts up to 24 inches wide and double wall for larger dimensions.

2.11 REMOTE DAMPER OPERATORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Pottorff; a division of PCI Industries, Inc.
2. Ventfabrics, Inc.
3. Young Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass.

D. Cable: Stainless steel.

E. Wall-Box Mounting: Recessed, 2 inches (50 mm) deep.

F. Wall-Box Cover-Plate Material: Stainless steel.

2.12 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. McGill AirFlow LLC.
5. Nailor Industries Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Vision panel.
d. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.
b. Access Doors up to 18 Inches (460 mm) Square: Two hinges and two sash locks.
c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches.
d. Access Doors Larger Than 24 by 48 Inches (600 by 1200 mm): Four hinges and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 6-inch wg (2500 Pa).
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.

7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.13 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to 2 strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd. (810 g/sq. m).
2. Minimum Tensile Strength: 500 lbf/inch (88 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch (6-mm) movement at start and stop.

2.14 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.

3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
4. Thermaflex

B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).
4. Insulation R-value: 8.0 at 72 deg F.

C. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.

2.15 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. Control devices requiring inspection.
8. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Minimum Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
5. Body Access: 25 by 14 inches (635 by 355 mm).
6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).

K. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Do not use flexible ducts to change directions.

O. Connect diffusers and / or diffuser boxes to ducts directly or with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.

P. Connect flexible ducts to metal ducts with draw bands plus sheet metal screws.

Q. Install duct test holes where required for testing and balancing purposes.

R. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

SECTION 23 34 23 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Centrifugal roof ventilators.
2. Ceiling-mounting ventilators.
3. In-line centrifugal fans.
4. Propeller fans.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on sea level.

B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Roof curbs.
6. Fan speed controllers.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

C. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Greenheck.

2. Loren Cook Company.
3. Penn Barry.

B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains and grease collector.
2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:

1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
4. Fan and motor isolated from exhaust airstream.

F. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent for direct drive fans.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.

G. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- (40-mm-) thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) pre-treated wood nailer. Size as required to suit roof opening and fan base.

1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: 18 inches (450 mm).
3. Sound Curb: Curb with sound-absorbing insulation matrix where indicated.
4. Pitch Mounting: Manufacture curb for roof slope.
5. Metal Liner: Galvanized steel.
6. Mounting Pedestal: Galvanized steel with removable access panel.

H. Capacities and Characteristics: Refer to Mechanical Equipment Schedule for capacities.

2.2 CEILING-MOUNTING VENTILATORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Greenheck.
2. Loren Cook Company.
3. Penn Barry.

B. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.

C. Housing: Steel, lined with acoustical insulation.

D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

E. Grille: Painted aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.

F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

G. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
3. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
4. Isolation: Rubber-in-shear vibration isolators.
5. Manufacturer's brick vent (as sized on the drawings) and transition fittings.

H. Capacities and Characteristics: Refer to Mechanical Equipment Schedules for capacities.

2.3 IN-LINE CENTRIFUGAL FANS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Greenheck.
2. Loren Cook Company.
3. Penn Barry.

B. Description: In-line, direct-driven centrifugal fans consisting of insulated housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

C. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

D. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing with whee4l inlet cone and motor on swing out service door.

E. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and copper lubricating tubes from fan bearings extended to outside of fan housing.

F. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

G. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent for direct drive fans.
2. Companion Flanges: For inlet and outlet duct connections.
3. Fan Guards: 1/2- by 1-inch (13- by 25-mm) mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

H. Capacities and Characteristics: Refer to Mechanical Equipment Schedules for capacities.

1. Vibration Isolators:

a. Type: Elastomeric hangers.
b. Static Deflection: 1 inch (25 mm).

2.4 PROPELLER FANS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Greenheck.
2. Loren Cook Company.
3. Penn Barry.

B. Description: Direct- or belt-driven propeller fans consisting of fan blades, hub, housing, orifice ring, motor, drive assembly, and accessories.

C. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.

D. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.

E. Belt-Driven Drive Assembly: Resiliently mounted to housing, statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.

1. Service Factor Based on Fan Motor Size: 1.4.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.

   a. Ball-Bearing Rating Life: ABMA 9, L_{10} of 100,000 hours.

4. Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.
5. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
6. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
7. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

F. Accessories:

1. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
2. Wall Sleeve: Galvanized steel to match fan and accessory size.
3. Weathershield Front Guard: Galvanized steel with expanded metal screen.
4. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

G. Capacities and Characteristics: Refer to Mechanical Equipment Schedules for capacities.

2.5 MIXED-FLOW FANS

A. Basis of design product: Subject to compliance with requirements provide the product indicated on the drawings or a comparable product of one of the following:

1. Greenheck
2. Loren Cook
3. Twin City

B. Source Limitations: Obtain mixed-flow fans from single manufacturer.

C. Description: Fan wheel and housing, straightening vane section, factory-mounted motor with belt drive or direct drive, and accessories.

D. Housings: Steel Galvanized steel or Aluminum.

1. Inlet and Outlet Connections: Outer mounting frame and companion flanges.
2. Guide Vane Section: Integral guide vanes downstream from fan wheel designed to straighten airflow.

E. Wheel Assemblies: Cast aluminum with airfoil-shaped blades mounted on cast-iron wheel plate keyed to shaft with solid-steel key.

F. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

1. Service Factor Based on Fan Motor Size: 1.2.
2. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
3. Fan Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.
4. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
5. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
6. Motor Base: Adjustable rail mount motor base with adjustment screw to set belt tension.
7. Shaft Bearings: Radial, self-aligning bearings.

a. Ball-Bearing Rating Life: ABMA 9, L10 of 100,000 hours.
b. Roller-Bearing Rating Life: ABMA 11, L10 of 100,000 hours.
c. Extend lubrication lines to outside of casing and terminate with grease fittings.

G. Accessories:

1. Mounting Clips: Horizontal ceiling and Vertical mounting clips welded to fan housing, of same material as housing.
2. Factory-wired motor disconnect switch located on outside of fan housing.

H. Factory Finishes:

1. Sheet Metal Parts: Prime coat before final assembly.
2. Exterior Surfaces: Baked-enamel finish coat after assembly.

2.6 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices and Wiring: Comply with requirements for electrical devices and connections specified in Division 25 sections.

B. Enclosure Type: Totally enclosed, fan cooled.

C. Provide ECM type where indicated on the drawings.

2.7 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Support units using elastomeric mounts and spring isolators having a static deflection of 1 inch (25 mm). Vibration- and seismic-control devices are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

1. Secure vibration controls to concrete bases using anchor bolts cast in concrete base.

C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 23.

D. Secure roof-mounting fans to roof curbs with stainless steel hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.

E. Ceiling Units: Suspend units from structure; use steel rod or metal straps with vibration isolators.

F. Support suspended units from structure using threaded steel rods and elastomeric hangers and spring hangers having a static deflection of 1 inch (25 mm). Vibration-control devices are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

G. Install units with clearances for service and maintenance.

H. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.

4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Verify lubrication for bearings and other moving parts.
7. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
8. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
9. Shut unit down and reconnect automatic temperature-control operators.
10. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust belt tension.

B. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

C. Replace fan and motor pulleys as required to achieve design airflow.

D. Lubricate bearings.

END OF SECTION

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Louver face diffusers.
2. Linear slot diffusers.
3. Heavy Duty Register.
4. Ceiling and Sidewall Return and Exhaust Grilles.
5. Adjustable Bar Supply Registers – Standard.
6. Adjustable Bar Supply Registers – Spiral Duct-Mounted.
7. Egg Crate Grille.
8. Door Transfer Grille.

B. Related Sections:

1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
3. Diffusers, registers, and grilles shall be tested in accordance with ANSI/ASHRAE 70-1991.

B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

E. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Square and Rectangular Louver Face Diffuser:

1. Basis-of-Design Product: The manufacturer shall provide published performance data for the diffuser. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991. Subject to compliance with requirements, provide Titus Model TDC, as indicated on the drawings or comparable product by one of the following:

   a. Krueger.
   b. METALAIRE, Inc.
   c. Price Industries.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Construction shall be of steel except for the Kitchen, locker rooms, shower rooms, and science labs/prep rooms which shall be aluminum.
4. Finish: The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315 deg F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM D117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250 hour ASTM 0870 Water Immersion Test. The paint must also pass the ASTM D-2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
5. Face Size: 24” x 24” for T-bar ceilings.
6. Mounting: Border Type 3 for lay-in ceilings, Border Type 1 for surface-mounting and Border Type 6, beveled drop face, for exposed locations. Refer to Architectural Drawings for finish type.
7. Pattern: An inner core assembly consisting of fixed deflection louvers shall be available in 1, 2, (2-way opposite and 2-way corner) 3, or 4-way horizontal discharge patterns. The inner core assembly must be removable in the field without tools for easy installation or cleaning.

2.2 CEILING LINEAR SLOT OUTLETS

A. Linear Slot Diffuser:

1. Manufacturers: The manufacturer shall provide published performance data for the linear slot diffuser. The linear slot diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991. Subject to compliance with requirements, provide products by Titus ML Series or comparable product by one of the following:

   a. Krueger.
   b. METALAIRE, Inc.
   c. Price Industries.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material - Shell: The frame and support bars shall be constructed of heavy gauge extruded aluminum.
4. Material - Pattern Controller and Tees: The pattern controller shall be an aerodynamically curved ice-tong shaped steel deflector capable of 180 degree pattern adjustment from the face of the diffuser and shall allow dampering if required. Maximum pattern controller length shall be 3 feet. For diffusers longer than 3 feet, pattern controllers shall be furnished in multiple sections.
5. Finish: The finish shall be #26 white. For wood finish ceilings, provide custom wood finish as selected by the architect to match proposed ceiling finish the finish shall be an anodic acrylic paint, baked at 315 deg F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM D117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250 hour ASTM 0870 Water Immersion Test. The paint must also pass the ASTM D-2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
6. Finish – Pattern Controller: #84 Black.
7. Slot Width: 1/2 inch, 3/4 inch, 1 inch, slot spacing of sizes shown on plans.

8. Number of Slots: 1 to 8 as shown on Plans.
9. Length: Shown on Plans.
10. Accessories: Linear slot diffusers shall be available in standard one-piece lengths up to 6 feet and 1 to 8 discharge slots. Diffuser lengths greater than 6 feet shall be furnished in multiple sections and will be joined together end-to-end with alignment pins to form a continuous slot appearance. All alignment components are to be provided by the manufacturer.

    a. Adjustable Pattern Controller.
    b. Frame and Border Type 4 with flange border, concealed mounting.
    c. Type X-X End Border.
    d. Miter Corners
    e. Blank Off Covers

2.3 REGISTERS AND GRILLES

A. Heavy Duty Register:

1. Basis-of-Design Product: The manufacturer shall provide published performance data for the grille. The grille shall be tested in accordance with ANSI/ASHRAE Standard 70-1991. Subject to compliance with requirements, provide Titus Model 33-R, one-half-inch bar spacing and 38 degree deflection or comparable product by one of the following:

    a. Metallaire, Inc.
    b. Krueger.
    c. Price Industries.

2. Material: Material shall be 16 gauge steel border and 14 gauge steel blades.
3. Finish: The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315 deg F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM D117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250 hour ASTM 0870 Water Immersion Test. The paint must also pass the ASTM D-2794 Reverse Impact Cracking Test with as 50-inch pound force applied.
4. Face Arrangement: As shown on the Device Schedule..
5. Deflection Bars: The fixed deflection bars shall be parallel to the long or short dimension (parallel with the floor) of the grille or register. Bars shall be 14 gauge steel. Bars shall be reinforced by perpendicular, steel support bars spaced on six-inch maximum centers.
6. Frame: One and one-quarter-inch border width on all sides and a minimum border gauge thickness of 16. Corners shall be welded with full penetration resistance welds with a reinforcing patch for extra strength.
7. Mounting Frame: Refer to Architectural Drawings for finish type.
8. Mounting: Countersunk screw.

B. Fixed Face Ceiling and Sidewall Return and Exhaust Grille:

1. Manufacturers: The manufacturer shall provide published performance data for the grilles. The grilles shall be tested in accordance with ANSI/ASHRAE Standard 70-1991. For filter return grilles, provide one-inch thick filters and 1/4-turn fasteners. Subject to compliance with requirements, provide Titus – Series 350 RL, Series 350 RLF1or comparable product by one of the following:

    a. Krueger.
    b. Price Industries.
    c. Metallaire, Inc.

2. Material: Construction shall be steel except for Science/Prep/Storage Rooms, Janitor Closets, Locker Rooms, Team Rooms, Shower Rooms, Kitchen and Dining Areas, which shall be aluminum.
3. Finish: The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315 deg F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM D117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250 hour ASTM 0870 Water Immersion Test. The paint must also pass the ASTM D-2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
4. Face Size: 24” x 24” for lay-in ceilings, as shown on Air Device Schedule (3/4” blade spacing).

5. Deflection Blades: The fixed deflection blades shall be parallel to the long dimension (or the floor for sidewall installations) of the register. Deflection blades shall be contoured to a specifically designed and tested cross-section to meet published test performance data. Blades shall be firmly held in place by mullions from behind the grille and fixed in place by crimping or welding. Blade deflection angle shall be available at 35 degrees.
6. Frame: One and one-quarter-inch border width on all sides and a minimum border gauge thickness of 16. Corners shall be welded with full penetration resistance welds with a reinforcing patch for extra strength.
7. Mounting Frame: Border Type 3 for lay-in ceilings, Border Type 1 for surface mount or exposed conditions. Refer to Architectural Drawings for finish type.
8. Mounting: Countersunk screw.
9. Provide 1" thick filter return air grilles with filter where indicated on the drawings.

C. Adjustable Bar Supply Air Register (Standard Type)
1. Basis-of-Design Product: The manufacturer shall provide published performance data for the diffuser. The register shall be tested in accordance with ANSI/ASHRAE Standard 70-1991. Subject to compliance with requirements, provide Titus 300RS, double deflection register or comparable product by one of the following:
   a. METALAIRE, Inc.
   b. Price Industries.
   c. Krueger.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Register shall be constructed of steel with 1-1/4" wide border on all sides.
4. Finish: The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315 deg F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM D117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250 hour ASTM 0870 Water Immersion Test. The paint must also pass the ASTM D-2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
5. Mounting: Shown on air device schedule.
6. Deflection: Double deflection with blades spaced on 3/4" centers. Blades shall have steel friction pivots on both ends to allow for individual blade adjustment. Front blades shall be parallel t the short dimension.
7. Accessories:

   a. Equalizing grid.
   b. Volume Extractor AG-45 with operator.

D. Adjustable Bar Supply air Register (Spiral Duct-Mounted Register):
1. Basis-of-Design Product: The manufacturer shall provide published performance data for the diffuser. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991. Subject to compliance with requirements, provide Titus S300FS direct duct-mounted, double deflection with radius end caps or comparable product by one of the following:
   a. METALAIRE, Inc.
   b. Price Industries.
   c. Krueger.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Diffuser shall be constructed of heavy duty extruded aluminum frame with 1-3/8" wide border and radius end caps with foam gaskets. Blades shall be constructed of heavy gauge extruded aluminum, 3/4" spacing and face blades parallel to the short dimension. Blades shall be individually adjustable.
4. Finish: The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315 deg F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM D117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250 hour ASTM 0870 Water Immersion Test. The paint must also pass the ASTM D-2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
5. Mounting: Shown on air device schedule.
6. Pattern: The airflow discharge pattern shall be field adjustable from horizontal to vertical by rotating a ring operator to open (vertical discharge) or close (horizontal discharge) the inner vane

assembly. The inner vane assembly must be easily removable as a unit. The ring operator shall be adjustable with a pole of remote access.

7. Dampers: Round damper shall be constructed of heavy gauge steel. Damper must be operable from the face of the diffuser by removing the inner vane assembly.
8. Accessories:

    a. Air Scoop Damper Model ASD.

E. Eggcrate Grille:
1. Basis-of-Design Product; Subject to compliance with requirements, provide Titus 50F and 50FF for filter grille, or comparable product by one of the following:
    a. Krueger.
    b. Price Industries.
    c. METALAIRE, Inc.
2. Material: Aluminum.
3. Finish: Same as all others.
4. Face Arrangement: 1/2 by 1/2 by 1/2 inch (13 by 13 by 13mm grid).
5. Core Construction: Integral aluminum core.
6. Frame: 1-1/4 inches (32 mm) wide.
7. Mounting Frame: Filter where indicated.
8. Mounting: countersunk screw for surface-mount (Border Type 1) and (Border Type 3) for T-bar ceiling.
9. Accessory One-inch filter with 1/4-turn fastener.

F. Door Transfer Air Grille:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Titus T700L with auxiliary frame or comparable product by one of the following:
    a. Krueger.
    b. Price Industries.
    c. METALAIRE, Inc.
2. Material: 20 gauge steel.
3. Finish: Same as all others.
4. Deflection Bars: Inverted “V” blades with a deflection angle of 77 degrees (site proof).
5. Frame: 1-1/4 inches (32 mm) wide.
6. Mounting Frame: Surface mount with auxiliary frame.
7. Mounting: Countersunk screw.

2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air

volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

D. Supply diffusers shall be square neck type with contractor fabricated internally lined plenum boxes.

E. Diffusers located in corridors shall be two-way blow type.

F. All terminal air devices located in janitor closets, and mechanical/electrical equipment rooms shall be constructed of aluminum.

G. All terminal air devices shall be painted white unless indicated otherwise.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 37 23 - HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Louvered-penthouse ventilators.
2. Roof hoods.
3. Goosenecks.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design ventilators, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Ventilators shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of ventilator components, noise or metal fatigue caused by ventilator blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on a uniform pressure of 20 lbf/sq. ft. (960 Pa), acting inward or outward.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1-2004.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. For louvered-penthouse ventilators specified to bear AMCA Seal, include printed catalog pages showing specified models with a appropriate AMCA-Certified Ratings Seals.

B. Shop Drawings: For gravity ventilators. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.

C. Coordination Drawings: Roof framing plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members to which roof curbs and ventilators will be attached.
2. Sizes and locations of roof openings.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.

C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 (Z275) zinc coating, mill phosphatized.

D. Stainless-Steel Sheet: ASTM A 666, Type 304, with No. 4 finish.

E. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.

1. Use types and sizes to suit unit installation conditions.
2. Use Phillips flat -head screws for exposed fasteners unless otherwise indicated.

F. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components, with capability to sustain without failure a load equal to 4 times the loads imposed for concrete, or 6 times the load imposed for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.

D. Fabricate supports, anchorages, and accessories required for complete assembly.

E. Perform shop welding by AWS-certified procedures and personnel.

2.3 LOUVERED-PENTHOUSE VENTILATORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Greenheck Fan Corporation.
2. Loren Cook Company.
3. Ruskin.

B. Construction: All-welded assembly with 4-inch (100-mm)-deep louvers, mitered corners, and aluminum sheet roof with mineral-fiber insulation and vapor barrier.

C. Frame and Blade Material and Nominal Thickness: Extruded aluminum, of thickness required to comply with structural performance requirements, but not less than 0.080 inch (2.0 mm) for frames and 0.080 inch (2.0 mm) for blades.

1. Exterior Corners: Prefabricated corner units with mitered and welded blades and with fully recessed mullions at corners.
2. AMCA Seal: Mark units with the AMCA-Certified Ratings Seal.

D. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- (40-mm-) thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailer. Size as required to fit roof opening and ventilator base.

1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: 18 inches (450 mm).

E. Screening: Aluminum, ½" mesh bird screen.

F. Capacities and Characteristics: Refer to Mechanical Drawings for capacities.

2.4 GOOSENECKS

A. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," Figure 5-5; with a minimum of 0052-inch –(1.3-mm) thick, galvanized steel sheet.

B. Roof Curbs; Galvanized steel sheet; with mitered and welded corners; 1-1/2-inch (40-mm) thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailer. Size as required to fit roof opening and ventilator base.

1. Configuration: Self-flashing without a cant strip, with mounting flange.
2. Overall Height: 18 inches (450 mm).

C. Screening: Aluminum, ½" mesh bird screen.

D. Galvanized Steel Sheet Finish:

1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.

E. Capacities and Characteristics: Refer to Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.

B. Install goosenecks on curb base where throat size exceeds 9 by 9 inches (230 by 230 mm).

C. Install gravity ventilators with clearances for service and maintenance.

D. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Division 07 Section "Joint Sealants" for sealants applied during installation.

F. Label gravity ventilators according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

G. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

H. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

I. All curbs shall be 18” minimum above finished roof.

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

A. Adjust damper linkages for proper damper operation.

END OF SECTION

SECTION 23 51 00 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Listed double-wall vents and chimneys.

B. Related Sections include the following:

1. Division 23 Section "Draft Control Devices" for induced-draft and mechanical fans and for motorized and barometric dampers.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Building-heating-appliance chimneys.

B. Shop Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, hangers and seismic restraints, and location and size of each field connection.
2. The inner diameter for breaching and stack shall be verified by the Manufacturers computation. The computation shall be technically sound. Shall follow ASHRAE calculation methods and incorporate the specific flow characteristics of the inner pipe. The Contractor shall furnish the exact boiler model and operating characteristics to the factory representative. Operating Characteristics shall include flue gas flow rate, BTU input, outlet temperature, local altitude, stack layout, and available external pressure at boiler outlet, etc., necessary to determine system operation at maximum and minimum levels of burner turndown range.

C. Welding certificates.

D. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain listed system components through one source from a single manufacturer.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," for hangers and supports and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents, breechings, and stacks.

C. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of venting system that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, structural failures caused by expansion and contraction.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LISTED BUILDING-HEATING-APPLIANCE CHIMNEYS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Schebler Co. AL29-4C stainless steel flue, or a comparable product by one of the following:

1. Heat-Fab, Inc.
2. Metal Fab
3. Selkirk Inc.; Selkirk Metalbestos and Air Mate.
4. Van-Packer Company, Inc.
5. Jeremias

B. Construction: Inner shell and outer jacket separated by at least a 1-inch (25-mm) annular space.

C. Inner Shell: ASTM A 666, Type 316 stainless steel or type AL29-AC stainless steel.

D. Description: Double-wall metal vents tested according to UL 1738 (special gas vent), lifetime warranty; with neutral or negative or positive flue pressure complying with NFPA 54.

E. Outer Jacket: Type 304 or 409 stainless steel.

F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

1. Termination: Rain cap with drain section incorporated into riser.

2.2 GUYING AND BRACING MATERIALS

A. Cable: Three galvanized, stranded wires of the following thickness:

1. Minimum Size: 1/4 inch (6 mm) in diameter.
2. For ID Sizes 4 to 15 Inches (100 to 381 mm): 5/16 inch (8 mm).
3. For ID Sizes 18 to 24 Inches (457 to 610 mm): 3/8 inch (9.5 mm).

4. For ID Sizes 27 to 30 Inches (685 to 762 mm): 7/16 inch (11 mm).
5. For ID Sizes 33 to 36 Inches (838 to 915 mm): 1/2 inch (13 mm).
6. For ID Sizes 39 to 48 Inches (990 to 1220 mm): 9/16 inch (14.3 mm).
7. For ID Sizes 51 to 60 Inches (1295 to 1524 mm): 5/8 inch (16 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Listed Building-Heating-Appliance Chimneys: Dual-fuel boilers, oven vents, water heaters, and exhaust for engines.

3.3 INSTALLATION OF LISTED VENTS AND CHIMNEYS

A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

B. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

D. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.

E. Lap joints in direction of flow.

F. Connect base section to foundation using anchor lugs of size and number recommended by manufacturer.

G. Join sections with acid-resistant joint cement to provide continuous joint and smooth interior finish.

H. Erect stacks plumb to finished tolerance of no more than 1 inch (25 mm) out of plumb from top to bottom.

I. Provide AL29-4C SS flue and all associated accessories for all condensing boilers and water heaters in a fully turnkey fashion. Install per the manufacturers recommendations, IMC and NFPA requirements.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.

C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION

SECTION 23 52 16 - CONDENSING BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged, factory-fabricated and -assembled, gas-fired, fire-tube condensing boilers, trim, and accessories for generating hot water.

1.3 SUBMITTALS

A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Source quality-control test reports.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

F. Warranty: Special warranty specified in this Section.

G. Other Informational Submittals:

1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers."

E. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Condensing Boilers:

a. Leakage and Materials: 10 years from date of Substantial Completion.
b. Heat Exchanger Damaged by Thermal Stress and Corrosion: Nonprorated for five years from date of Substantial Completion.
c. Everything else not covered above shall be provided with a three (3) year warranty from substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Airco Benchmark as indicated on Drawings or a comparable product by one of the following:

1. Fulton Endura
2. Riello Array
3. Cleaver Brooks.

2.2 MANUFACTURED UNITS

A. Description: Factory-fabricated, -assembled, and -tested, vertical stainless steel fire-tube **or water tube**[1] condensing boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections with acid neutralizing trap; and controls. Water heating service only.

B. Heat Exchanger: Nonferrous, corrosion-resistant combustion chamber. Type 316L stainless steel tubes and tube sheets.

C. Pressure Vessel: Carbon steel with welded heads and tube connections.

D. Burner: Natural gas, forced draft.

E. Blower: Centrifugal fan to operate during each burner firing sequence and to prepurge and postpurge the combustion chamber.

[1] VE GMP

1. Motors: Comply with requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
    a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

F. Gas Train: Combination gas valve with manual shutoff and pressure regulator.

G. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.

H. Casing:

1. Jacket: Sheet metal, with snap-in or interlocking closures.
2. Control Compartment Enclosures: NEMA 250, Type 1A.
3. Finish: Baked-enamel or powder coated] protective finish.
4. Insulation: Minimum 2-inch- (50-mm-) thick, mineral-fiber insulation surrounding the heat exchanger.
5. Combustion-Air Connections: Inlet and vent duct collars.
6. Mounting base to secure boiler.

I. Characteristics and Capacities:

1. Heating Medium: Hot water.
2. Design Water Pressure Rating: 160 psig (1100 kPa).
3. Safety Relief Valve Setting: 80 psig.
4. Refer to drawings for additional information.

2.3 TRIM

A. Include devices sized to comply with ANSI B31.9, "Building Services Piping."

B. Aquastat Controllers: Operating, firing rate, and high limit.

C. Safety Relief Valve: 80 PSIG ASME rated.

D. Pressure and Temperature Gauge: Minimum 3-1/2-inch- (89-mm-) diameter, combination water-pressure and -temperature gage. Gauges shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.

E. Boiler Air Vent: Manual.

F. Drain Valve: Minimum NPS 3/4 (DN 20) hose-end ball valve.

G. Condensate acid neutralization trap.

H. Low water cut-off.

2.4 CONTROLS

A. Refer to Division 23 Section "Instrumentation and Control for HVAC."

B. Boiler operating controls shall include the following devices and features:

1. Control transformer.
2. Set-Point Adjust: Set points shall be adjustable.

C. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

1. High Cutoff: Manual reset stops burner if operating conditions rise above maximum boiler design temperature.
2. Low-Water Cutoff Switch: Hydro Level 550 Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manual-reset type.
3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

D. Building Automation System Interface: Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms.

1. Hardwired Points:

   a. Monitoring: On/off status, common trouble alarm, [low water level alarm.
   b. Control: On/off operation, hot water supply temperature set-point adjustment.

2. A communication interface with building automation system shall enable building automation system operator to remotely control and monitor the boiler from the Johnson Controls BAS. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through and integrate with the Building Automation System (BAS).

2.5 ELECTRICAL POWER

A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

B. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

1. House in NEMA 250, Type 1 enclosure.
2. Wiring shall be numbered and color-coded to match wiring diagram.
3. Install factory wiring outside of an enclosure in a metal raceway.
4. Field power interface shall be to a nonfused disconnect switch.
5. Provide each motor with overcurrent protection.

2.6 VENTING KITS

A. Kit: Complete system, ASTM A 959, Type 29-4C stainless steel, pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap and dilution tank, and sealant.

B. Combustion-Air Intake: Complete system, PVC intake pipe or stainless steel as recommended by the Boiler Manufacturer, vent terminal with screen, inlet air coupling, and sealant.

2.7 SOURCE QUALITY CONTROL

A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

B. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

C. Allow Owner access to source quality-control testing of boilers. Notify Architect 14 days in advance of testing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

A. Install boilers level on concrete base. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.

B. Vibration Isolation: Elastomeric isolation pads with a minimum static deflection of 0.25 inch (6.35 mm). Vibration isolation devices and installation requirements are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Install gas-fired boilers according to NFPA 54.

D. Assemble and install boiler trim.

E. Install electrical devices furnished with boiler but not specified to be factory mounted.

F. Install control wiring to field-mounted electrical devices.

G. Boiler shall have a remote or internal constant flow in-line circulator pump

H. Boiler controller shall interface with the Johnson Controls Building Automation System (BAS). All available control and monitoring points shall be integrated into the BAS via a Bacnet MSTP communications card/gateway. Coordinate all controls with the ATC Contractor.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Division 23 Section "Common Work Results for HVAC,"

E. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.

F. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

G. Connect condensate drain piping to acid neutralization trap and extend to closest floor drain.

H. Install piping from safety relief valves to nearest floor drain.

I. Install piping from safety valves to drip-pan elbow and to nearest floor drain.

J. Boiler Venting:

1. Install flue venting kit and combustion-air intake.
2. Connect full size to boiler connections.

K. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

L. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.
b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Remove and replace malfunctioning units and retest as specified above.

D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion , provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

E. Performance Tests:

1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
3. Perform field performance tests to determine capacity and efficiency of boilers.

a. Test for full capacity.
b. Test for boiler efficiency at 20, 40, 60, 80, 100, 80, 60, 40, and 20 percent of full capacity. Determine efficiency at each test point.

4. Repeat tests until results comply with requirements indicated.
5. Provide analysis equipment required to determine performance.
6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.
7. Notify Architect in advance of test dates.
8. Document test results in a report and submit to Architect.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to start up and to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Video training sessions by an audio/visual specialist. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 23 64 33.13 – SPLIT AIR-COOLED MODULAR CHILLER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The air-cooled modular chiller system shall consist of individual chiller modules that are assembled on site. Each chiller module shall be completely factory wired, and tested prior to shipment. Each module shall include a compressor, evaporator, air cooled condenser, and controls. Controls shall be designed on a distributed primary control system that allows the primary microprocessor to operate remaining secondary modules in the event of a malfunction of any secondary controller. The controls shall also be designed to allow each individual secondary microprocessor to operate on its own temperature sensor if there is a failure of the primary microprocessor.

1.3 SUBMITTALS

A. Product Data: For each compressor and condenser unit. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.

B. Shop Drawings: For compressor and condenser units. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members to which compressor and condenser units will be attached.
2. Liquid and vapor pipe sizes.
3. Refrigerant specialties.
4. Piping including connections, oil traps, and double risers.
5. Compressors.
6. Evaporators.

D. Field quality-control reports.

E. Operation and Maintenance Data: Operation and maintenance manuals with installation instructions for compressor and condenser units to include remote panel installation instructions, operation, and maintenance manuals.

F. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of compressor and condenser units and are based on the specific system indicated. See Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Standard for Refrigeration Systems."

D. ASHRAE/IESNA 90.1-2022 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2022, Section 6, "Heating, Ventilating, and Air-Conditioning."

E. Unit shall be constructed in accordance with the UL 60335 2-40 and NEC standards and be UL or ETL listed.

F. Unit shall be rated and tested in accordance with ARI 550/590 – Standard for Water Chilling Packages.

1.5 COORDINATION

A. Coordinate sizes and locations of structural steel supports.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

C. Coordinate location of piping and electrical rough-ins.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of compressor and condensing units that fail in materials or workmanship within specified warranty period.
   1. The mechanical contractor shall be responsible for the difference between the specified warranty and the manufacturer's warranty.

   2. Warranty Period: Five years parts, labor and loss of refrigerant from date of Substantial Completion.

1.7 REGULATORY REQUIREMENTS

A. Comply with codes and standards specified

1.8 VERIFICATION OF CAPACITY AND EFFICIENCY

A. All proposals for chiller performance must include an AHRI approved selection method. Verification of date and version of computer program selected or catalog is available through AHRI.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

B. Protect units on site from physical damage after unloading.

PART 2 - PRODUCTS

2.1 COMPRESSOR AND CONDENSER UNITS, AIR COOLED

A. Basis-of-Design Product: Subject to compliance with requirements, provide Trane Thermafit Air-Cooled Chiller AMC as indicated on Drawings or comparable product by one of the following:
   1. Multistack
   2. Jetson

B. Description
   1. Each module shall be assembled on a powder coated, formed galvanized sheet metal frame and formed sheet metal panels with coated and painted finish. The panels shall be easily removable for servicing. The module shall be shipped individually and assembled on site. Each module shall be fully charged with refrigerant and factory tested for capacity and controller functions prior to shipment. The modules shall function together as a single chiller.

C. Compressor:
   1. Hermetically sealed, scroll compressor on each refrigeration circuit each with rotalock connections, oil level sight glass, suction gas-cooled motor with solid-state sensors in the windings for overload protection, and circuit breaker protection. There shall be two independent compressors and refrigerant circuits per module. Compressors shall be mounted to the heavy gauge steel frame with rubber-in-shear vibration isolators
   2. Capacity Control: Variable Speed lead compressor on the lead refrigeration circuit for each module and standard scroll compressor on the lag refrigeration circuit for each module. The VSD scroll compressor shall provide smooth and efficient operation from 35HZ to 60 HZ for close temperature control. to allow operation to 10% of full load.
   3. Minimum independent refrigeration circuits per module: Two.

D. Refrigerant: R-32 or R454B.

E. Evaporators
   1. Dual circuit, brazed plate evaporator on each module constructed of 316 stainless steel plates and copper brazing. The fluid connections to each evaporator shall use roll grooved couplings for service convenience and ease of installation. Each evaporator shall be insulated with 3/4” closed cell insultation. The maximum refrigeration-side working pressure shall be 650 psi. Evaporator piping fluid velocity shall not exceed 10 fps at any point in the system.

F. Refrigerant Receiver
   1. A refrigerant receiver shall be included on each refrigeration circuit. Each shall be sized to accommodate the required system pump down capacity. Chillers with recievers that do not provide full system pump down capacity as indicated are not acceptable. The receivers shall be provided with service valves for service isolation. A pressure relief valve rated at 650 psi shall be installed on the refrigerant receiver and piped to the outside of the chiller cabinet.

G. Each evaporator branch line shall include a manual and electronic butterfly valve that allows variable flow. Fluid flows to each active module to match the cooling requirements of the chiller system. By isolating individual modules that are not operating, this allows the hydronic system to have variable primary flow. The valves shall be the slow opening type to minimize the sudden change in flow to the active modules. The valves shall have a minimum opening cycle time of 35 seconds between the fully closed and fully open position and shall have roll grooved connections. The valves shall have a minimum close off pressure of not less than 75 psi and shall be rated for al maximum working pressure of 300 psi. The actuators shall be rated for 24 VAC.

H. Filters
   1. A 40-mesh industrial grade filter strainer shall be factory installed between the header system and each brazed plate heat exchanger. The strainer shall be serviceable by isolation valves that permit each strainer to be removed and cleaned without shutting down fluid flow or power to the entire system and allowing the remaining modules to continue to operate. In-line strainers that require complete system shutdown for service and isolation are not acceptable

I. Fans
   1. All condenser fan motors shall be maintenance free, quiet, highly efficient Electronically Commutated Motors (ECM) with energy reduction capabilities of up to 35%. These variable speed fan assemblies shall vary fan motor RPM to maintain the refrigeration pressure of the chiller modules.
   2. Each fan contains a diffuser that shall improve the efficiency and reduce the noise of the ECM fans. By increasing the fan efficiency, the motor speed can be reduced thereby lowering the sound pressure.

J. Liquid Piping
   1. The chilled fluid piping shall be Schedule 40 steel and be insulated using closed cell pipe insulation to prevent condensation and to retain temperature. The pump module shall connect to the adjacent modules using roll grooved steel couplings and neoprene gaskets. Any type of module-to-module pipe connection external to the modules is unacceptable.

K. Refrigerant Piping and Accessories
   1. Refrigerant piping shall be Type K seamless copper, insulated with closed cell pipe insulation on the suction lines.
   2. Each refrigerant circuit shall include compressor rotalock service valves, solenoid valves for compressor pumpdown, and Schrader service valves in the suction, discharge, and liquid lines, liquid line sight glass with moisture indicator and a filter dryer.

L. Controls
   1. The primary chiller module shall incorporate the primary microprocessor controller. The primary microprocessor shall communicate with the remaining secondary microprocessors in each module via a local network communications protocol. The primary microprocessor shall include a phase monitor to protect against low voltage, phase unbalance, phase loss, and phase reversal conditions. The primary controller shall read all analog and fault port values from all secondary module controllers and shall pass these values to the Building Automation System via BACnet protocols. Each chiller control system shall include operational switches for each compressor; high and low pressure transmitters to provide indication of refrigeration pressures in each circuit; high and low refrigeration pressure alarms including shutting shut down the responsible compressor(s); anti-short cycling compressor timers; minimum compressor run timers; connection to Building Automation System. All functions of the control system shall be fully accessible to and be integrated with the Johnson Controls Building Automation System (BAS).

M. Microprocessor
   1. The microprocessor shall provide the following minimum functions and alarms:
      a. Adjustable fluid temperature setpoint
      b. Multiple stage compressor control, including compressor rotation to provide even compressor usage and wear.
      c. High and low fluid temperature alarm set points
      d. Water inlet and outlet temperature
      e. Suction and discharge refrigeration pressures
      f. Compressor run status
      g. Current alarm status
      h. Demand load
      i. Compressor run hours
      j. Alarm logging with minimum of previously 100 logged alarms with time and date of each occurrence
      k. Remote start stop input
      l. Dry contact for general alarm

N. Interface Panel
   1. An operator 7” touch screen interface panel with graphical display shall be installed on the master module to allow chiller operation monitoring, adjustment of user set points, and alarm monitoring.

O. Power: Individual power supply to a distribution block or circuit breaker disconnect in the electrical panel of each module.

P. Sound Accessories

1. Acoustical panels for low sound operation
2. Compressor sound wraps for low sound operation
3. ECM Condenser Fan motors

Q. Refrigerant monitoring and leak detection:
1. Provide Genesis International Sherlock 202 Control Module with 24 hour time clock, horn/strobe with two (2) sensors minimum (one for chiller and one for Water to water heat pump), 4 SPDT relays, 2-12V DC audible/visual output, two alarm levels, two SPDT relays with pushbutton keypad and LCD Display. Alarms shall include Buzzer, light strobe and display. Provide a relay for each alarm that can be silenceable when in alarm. Interlock with machine room ventilation/purge fan and damper system. Coordinate all interlock connection requirements with the ATC contractor. System shall comply with ASHRAE Standards, IMC requirements and shall be provided in a fully turnkey system

R. Capacities and Characteristics: Refer to Drawings

2.2 REMOTE AIR COOLED CONDENSER

A. General: There shall be one dual circuit remote air cooled condenser paired with each chiller module. The remote condenser shall be shipped complete with a nitrogen charge. Service valves with access ports allow for pressure testing and evacuation of field installed refrigeration piping. Each condenser shall have its own power supply to a non-fused disconnect switch.

B. Fan Motors: All condenser fan motors shall be EC type.

C. Variable speed EC fans shall be provided for quieter operation and improved head pressure control down to 0 degrees F ambient.

D. Fan Blades: the blades shall be non-corrosive, durable injected composite plastic blades that are dynamically balanced and factory tested prior to shipping.

E. Coils: Aluminum fins mechanically bonded to coppers tubes with integral subcooling circuits. Fin spacing shall not exceed 10 fins per inch. The coils shall be sized to provide full heat of rejection at jobsite elevation above sea level, at a maximum 25-degree F temperature difference between the condensing temperature and ambient air temperature. The coils shall be tested to a minimum of 600 psig.

F. Controls: The condenser controls shall include pressure actuated fan cycling controls on each condenser fan motor to maintain proper head pressure control in ambient temperatures down to 10-degree F.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate compressor and condenser units according to ARI 340/360 and 365.

B. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1-2004, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," Section 6, "Heating, Ventilating, and Air-Conditioning."

C. Test and inspect shell and tube condensers according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. Testing Requirements: Factory test sound-power-level ratings according to ARI 270 and ARI 370.

E. The complete unit shall be UL listed.

2.5 LEAK DETECTION AND MONITORING SYSTEM

A. Provide a complete and fully turnkey leak detection and monitoring system for the chiller and water to water heat pump in accordance with the latest ASHRAE and IMC requirements. Provide individual refrigerant specific sensors at the chiller and water to water heat pump. Provide lights, horns, manual reset and interlocks for the purge system and interface with the Johnson Controls BAS. Unit shall be 120v.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of compressor and condenser units.

B. Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where compressor and condenser units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Provide cross plot of DX coil capacity and condensing unit capacity to determine saturated suction temperature.

3.2 INSTALLATION

A. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.

B. Install roof-mounting units on equipment supports.

C. Vibration Isolation: Mount compressor and condenser units on rubber pads with a minimum deflection of 1/4 inch (6.35 mm). Vibration isolation devices and installation requirements are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

D. Vibration Isolation: Mount compressor and condenser units on restrained spring isolators with a minimum deflection of 1-inch. Vibration isolation devices and installation requirements are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

E. Maintain manufacturers recommended clearances for service and maintenance.

F. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

G. The refrigerant piping system shall be a delegated design, fully turnkey system and installed per the manufacturers recommendations. Provide letter on manufacturers' letterhead stating the installation will maintain the 5 year warranty and has been installed per the manufacturers' recommendations. Include this document in the O&M Manual.

3.3 CONNECTIONS

A. Comply with requirements for piping in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

C. Connect precharged refrigerant tubing to unit's quick-connect fittings. Install tubing so it does not interfere with access to unit. Install furnished accessories.

D. Connect refrigerant piping to air-cooled compressor and condenser units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in Division 23 Section "Refrigerant Piping." Install all manufacturers recommended specialties. Provide isolation service valves to isolate evaporator and condenser refrigerant.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.
2. Leak Test: After installation, charge system with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor operation and unit operation, product capability, and compliance with requirements.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Verify proper airflow over coils.

C. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

D. Compressor and condenser units will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

a. Inspect for physical damage to unit casing.
b. Verify that access doors move freely and are weathertight.
c. Clean units and inspect for construction debris.

d. Verify that all bolts and screws are tight.
e. Adjust vibration isolation and flexible connections.
f. Verify that controls are connected and operational.

B. Lubricate bearings on fan motors.

C. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.

D. Adjust fan belts to proper alignment and tension.

E. Start unit according to manufacturer's written instructions and complete manufacturer's startup checklist.

F. Measure and record airflow and air temperature rise over coils.

G. Verify proper operation of condenser capacity control device.

H. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

I. After startup and performance test, lubricate bearings.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain compressor and condenser units.

END OF SECTION 236200

SECTION 23 72 23.19 – PACKAGED INDOOR FIXED PLATE ENERGY RECOVERY UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Fixed-plate, total heat exchangers in packaged, indoor, energy-recovery units.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include packaged, indoor, fixed-plate, energy-recovery unit rated capacities, operating characteristics, furnished specialties, and accessories.
   2. Fans:

      a. Certified fan-performance curves with system operating conditions indicated.
      b. Certified fan-sound power ratings.
      c. Fan construction and accessories.
      d. Motor ratings, electrical characteristics, and motor accessories.

B. Shop Drawings: For packaged, indoor, fixed-plate, energy-recovery units.

   1. Include plans, elevations, sections, details, and mounting and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, elevations, and other details, drawn to scale. and coordinated with each other, using input from installers of the items involved.

B. Seismic Qualification Data: Certificates, for packaged, indoor, fixed-plate, energy-recovery units, accessories, and components, from manufacturer.

   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-to-air energy recovery equipment to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: Three (3) set(s) of each type of filter specified.
2. Fan Belts: One set of belts for each belt-driven fan in energy recovery units.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of packaged, indoor, fixed-plate, energy-recovery units that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Packaged Energy-Recovery Units: Two years.
2. Warranty Period for Fixed-Plate Total Heat Exchangers: 10 years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

B. ASHRAE Compliance:

1. Applicable requirements in ASHRAE 62.1.
2. Capacity ratings for fixed-plate energy-recovery units shall comply with ASHRAE 84.

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.

D. UL Compliance:

1. Packaged heat-recovery ventilators shall comply with requirements in UL 1812 or UL 1815.
2. Electric coils shall comply with requirements in UL 1995.

E. Energy core performance shall be AHRI certified per standard 1060.

2.2 CAPACITIES AND CHARACTERISTICS

A. Type: Fixed-plate energy-recovery unit.

B. Refer to drawings for performance requirements and capacities.

2.3 PACKAGED, INDOOR, FIXED-PLATE TOTAL ENERGY RECOVERY UNITS

A. Manufacturers:
   1. Subject to compliance with the specifications and drawings, provide RenewAir HE series or equal of Greenheck or Oxygen 8.

B. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Housing: Manufacturer's standard double wall construction (20 ga minimum) with corrosion-protection coating and exterior finish, gasketed, hinged access doors or removable panels with neoprene gaskets for inspection and access to internal parts, minimum 1-inch (25-mm) thick R5 thermal insulation, knockouts for electrical connections, exterior drain connection, and lifting lugs.

D. Fixed-Plate Total Heat Exchanger:

   1. Casing: Galvanized steel (G90 minimum).

   2. Passive Frost Control down to -10f outside air at 40% indoor RH

   3. Provide enthalpy economizer bypass motorized integral dampers
   4. Plates: Evenly spaced and sealed and arranged for counter or cross flow.

      a. Plate Material: Chemically treated paper or polymer membrane with selective hydroscopicity and moisture permeability, and gas barrier properties.

E. Supply and Exhaust Fans:

   1. Motor and Drive: Direct driven backward inclined electronically communicated (EC) type with speed control.
   2. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
   3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   4. Outside air and relief fans shall blow through filter and heat recovery core heat exchanger for supply and exhaust air connections.
   5. Provide duct flanges at all connections
   6. Terminal strip for EC motor control

F. Filters:

   1. Description: 2” thick, Pleated factory-fabricated, self-supported, disposable air filters with holding frames.
   2. UL Compliance: Comply with UL 900.
   3. Filter Mounting Frames: Arranged with access doors or panels on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
   4. Provide 2” thick MERV 13 filters for the outside airstream and 2” thick MERV 8 on the exhaust air stream.
   5. Provide filter monitor

G. Wiring: Fabricate units with space within housing for electrical conduits. Wire motors and controls, so only external connections are required during installation.

   1. Indoor Enclosure: NEMA 250, Type 12 enclosure contains relays, starters, and terminal strip.
   2. Include non-fused disconnect switches.
   3. Include 24V transformer/relay package.

2.4 CONTROLS

A. Control Panel: Solid-state, programmable, microprocessor-based control unit (RenewAire Enhanced Commercial Controller) with BACnet gateway for wall mounting. Integrate to BACnet as specified in Section 230900.

B. Refer to control drawings and Sequence of Operation for control requirements including variable speed controlled fans and supply fan/exhaust fan tracking, isolation dampers, temperature monitoring, alarms, bypass control, etc. Provide transducers, sensors, filter monitoring, microprocessor controller with LED display, terminal strip for ATC etc. in a fully turnkey fashion as coordinated with the ATC Contractor.

C. Starting relay, factory mounted and wired, and manual motor starter for field wiring.

D. Dirty filter switch.

E. Low-Voltage Transformer: Integral transformer to provide control voltage to unit from primary incoming electrical service.

2.5 SOURCE QUALITY CONTROL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. AHRI Compliance: Capacity ratings for air-to-air energy-recovery equipment certified as complying with AHRI 1060.

C. Fan Performance Rating: Comply with AMCA 211 and label fans with AMCA-certified rating seal. Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency according to AMCA 210/ASHRAE 51.

D. Fan Sound Ratings: Comply with AMCA 301 or AHRI 260 (IP). Air-handling unit fan sound ratings shall comply with AMCA 301 or AHRI 260 (IP).

E. UL Compliance:

1. Packaged fixed plate energy recovery units shall comply with requirements in UL 1812; or UL 1815.
2. Electric Coils: Comply with UL 1995.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine casing insulation materials and filter media before packaged, indoor, fixed-plate, energy-recovery unit installation. Replace with new insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install packaged, indoor, fixed-plate, energy-recovery units, so supply and exhaust airstreams flow in opposite directions.

1. Install access doors in both supply and exhaust ducts, both upstream and downstream, for access to interior components.
2. Install removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.
3. Access doors and panels are specified in Section 233300 "Air Duct Accessories."

B. Equipment Mounting:

1. Install packaged, indoor, fixed-plate, energy-recovery units on 4-inch (100-mm) cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in [Section 033000 "Cast-in-Place Concrete."] [Section 033053 "Miscellaneous Cast-in-Place Concrete."]

C. Suspended Units: Suspend units from structural-steel support frame, using threaded steel rods and spring hangers. Comply with requirements for vibration-isolation devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

D. Install units with clearances for service and maintenance.

E. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

3.3 DUCTWORK CONNECTIONS

A. Comply with requirements for ductwork according to Section 233113 "Metal Ducts."

B. Connect duct to units with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."

C. Isolation Dampers: Install isolation dampers according to Section 230923.12 "Control Dampers."

3.4 ELECTRICAL CONNECTIONS

A. Install electrical devices furnished with units but not factory mounted.

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

E. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
1. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch (13 mm) high.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections with the assistance of a factory-authorized service representative.

C. Tests and Inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Packaged, indoor, fixed-plate, energy-recovery units will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.8 ADJUSTING

A. Adjust moving parts to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature and humidity setpoints.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy-recovery units.

END OF SECTION 237223.19

SECTION 23 73 13 - MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Constant-air-volume, single-zone air-handling units.
2. Variable-air-volume, single-zone air-handling units.
3. Dedicated Outdoor Air System Air Handling Units.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design vibration isolation and seismic-restraint details, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Casing panels shall be self-supporting and capable of withstanding 133 percent of internal static pressures indicated, without panel joints exceeding a deflection of L/240 where "L" is the unsupported span length within completed casings.

1.4 SUBMITTALS

A. Product Data: For each air-handling unit indicated.

1. Unit dimensions and weight with required clearances, field connection locations, wiring diagrams, and shipping drawings.
2. Cabinet material, metal thickness, finishes, insulation, and accessories.
3. Fans:
   a. Certified fan-performance curves with system operating conditions indicated.
   b. Certified fan-sound power ratings.
   c. Fan construction and accessories.
   d. Motor ratings, electrical characteristics, and motor accessories.
4. Certified coil-performance ratings with system operating conditions indicated.
5. Dampers, including housings, linkages, and operators.
6. Filters with performance characteristics, including Media, Assembly and Filter Frames.
7. Physical size, weight, and recommended clearance including individual modules, shipping sections and assembly requirements.

B. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Mechanical-room layout and relationships between components and adjacent structural and mechanical elements.
2. Support location, type, and weight.
3. Field measurements.

C. Source quality-control reports.

D. Field quality-control reports.

E. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

E. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. Comply with NFPA 70.

G. Manufacturer shall have a minimum of 25 years of experience in designing, manufacturing, and servicing air handling units.

H. The design indicated on the schedules and shown on the drawings is based upon the products of the named manufacturer. Alternate equipment manufacturers are acceptable if equipment meets scheduled performance requirements and dimensional requirements.

I. If equipment is supplied by a manufacturer other than the one named, coordinate with the General Contractor and affected subcontractors to ensure the specified performance is met. This coordination shall include (but is not limited to) the following:

1. Structural supports for units.
2. Size and location of concrete bases/housekeeping pads.
3. Location of recommended access for service and maintenance
4. Ductwork sizes and connection locations.
5. Piping size and connection/header locations.
6. Interference with existing or planned ductwork, piping, and wiring.
7. Electrical power requirements and wire/conduit and overcurrent protection sizes.
8. Trap height requirements.

J. The Mechanical Contractor shall be responsible for costs incurred by the General Contractor, Subcontractors, and Consulting Engineers to accommodate units furnished by a manufacturer other than manufacturer named as basis of design. Cost include redesign of structural supports by a licensed structural engineer and submittal for review.

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: Three sets for each air-handling unit.
2. Gaskets: One set for each access door.

1.8 REFERENCES

A. AMCA 99 – Standard Handbook

B. AMC 210 – Laboratory Methods of Testing Fans for Rating Purposes

C. AMCA 500 – Test Methods for Louvers, Dampers, and Shutters.

D. ANSI/AFBMA 9 – Load Ratings and Fatigue Life for Ball Bearings.

E. ANSI/UL 900 – Test Performance of Air Filter Units.

F. ARI 410 - Forced-Circulation Air Cooling and Air Heating Coils.

G. ARI 430-Testing and Rating of Central-Station Air Handling Units.

H. ASHRAE 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings.

I. NFPA 70 – National Electric Code (Conductors, equipment and raceways).

J. NFPA 90A – Installation of Air Conditioning and Ventilation Systems.

K. SMACNA – HVAC Duct Construction Standards.

L. UL-1995 – Standard for Safety for Heating and Cooling Equipment.

M. AFBMA 9 – Load Ratings and Fatigue Life for Ball Bearings.

N. ARI 435 - Application of Central-Station Air-Handling Units.

O. ASTMB117 – Standard Practice for Operating Salt Spray Apparatus.

P. NEMA MG1 – Motors and Generators.

Q. UL 723 – Test for Surface Burning Characteristics of Building Materials.

R. UL 900 – Test Performance of Air Filter Units.

S. UL 94 – Test for Flammability of Plastic Materials for Parts in Devices and Appliances.

T. IBC 2000, 2003 – International Building Code.

U. NFPA 5000 – Building Construction and Safety Code.

V. ARI Standard 1060 – Rating Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment.

W. GSA 2003 Facilities Standard – 5.9 HVAC Systems and Components.

1.9 DELIVERY, STORAGE AND HANDLING

A. Comply with ASHRAE 62, Section 5 (Mold and corrosion-resistant casing, filters upstream of wetted surfaces, and drain pan design).

B. Comply with ASHRAE 62, Section 7 (Practices to be followed during construction and startup). Protect equipment from moisture by appropriate in-transit and on-site procedures.

C. Follow manufacturer's recommendations for handling, unloading and storage.

D. Protect, pack, and secure loose-shipped items within the air handling units. Include detailed packing list of loose-shipped items, including illustrations and instructions for application.

E. Protect, pack and secure controls devices, motor control devices, and other electronic equipment. Do not store electronic equipment in wet or damp area s even when they are sealed and secured.

F. Enclose and protect control panels, electronic or pneumatic devices, and variable frequency drives; and pack with desiccant bags. Replace desiccant bags every 60 days. For equipment stored in an environment with a relative humidity greater than 60%, change bags every 30 days. Do not store equipment in wet or damp areas even when they are sealed and secured.

G. Seal openings to protect against damage during shipping, handling and storage.

H. Wrap indoor units with a tight sealing membrane. Wrapping membrane shall cover entire AHU during shipping and storage. Cover equipment, regardless of size or shape. Tarping is not acceptable.

I. Wrap equipment, including electrical components. For protection against rain, snow, wind, dirt, sun fading, road salt/chemicals, rust and corrosion. Keep equipment clean and dry.

J. Tarp outdoor units to protect against rain and road debris during shipping.

K. Clearly mark AHU sections with unit tag number, segment sequence number, and direction of airflow. Securely affix safety-warning labels.

1.10 RATINGS AND CERTIFICATIONS

A. Air Handling Unit Safety: ETL or UL 1995.

B. Air Handling Unit Energy Use: ASHRAE 90.1.

C. Fans: AMCA 210.

D. Air Coils: ARI 410.

E. Air Handling Unit Certification Program: ARI 430.

F. Filter Media: ANSI/UL 900 Listed Class I or Class II.

G. Control wiring: NEC Codes and ETL requirements.

H. Motors: Federally mandated Energy Policy Act (EPACT).

I. Airflow Monitoring Stations: AMCA 611-95.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Kilmor as indicated on the Drawings or comparable product by one of the following:

1. Trane
2. Daiken

2.2 GENERAL

A. Air Handling Unit (AHU) and Dedicated Outdoor Air System (DOAS) units consists of a structural base, insulated casing, access doors, fans, motors, motor controls, coils, filters, dampers, piezo rings, components, and accessories; as shown on drawings, schedules, and specifications. Units shall be manufactured in modules with individual segments (fan, coils, filter, plenum, access) being assembled in the field. Each segment shall be able to be removed and replaced in the future. Each segment shall be able to be rigged through doorways, existing structure, around infrastructure, etc. without affecting the building or its systems.

B. Provide AHU to meet the specified levels of performance for scheduled items including airflow, static pressure, cooling capacity, heating capacity, electrical characteristics, sound, casing leakages, panel deflection and casing thermal performance.

C. AHU shall maintain structural integrity when wall panels are removed.

D. Provide internal components and accessories as specified and scheduled. Components and accessories shall be installed by the AHU manufacturer in an ISO-9002 certified facility.

E. Ship units in one piece. Split units only where necessary for shipping and installation.

F. Manufacturer shall provide detailed, step-by-step instructions for disassembly and reassembly.

G. For AHU segments that must be broken down for rigging and installation: Segment shall be disassembled and reassembled by manufacturer's factory authorized service personnel.

H. Manufacturer shall perform a field leakage test to confirm 1% leakage.

I. Manufacturer shall provide a written statement confirming that the unit is built to the manufacturer's factory standards and that the unit will carry the full warranty for two (2) years after substantial completion.

J. For units other than the basis of design, provide all differences (size, weight, performance, access) shall be identified in the submittal as indicated in Section 230500.

K. Air handling units shall be constructed for ceiling suspension (horizontal) or floor mounting (vertical) applications.

L. For floor mounted units with bottom return, provide steel frame with inlet plenum box full size of unit connection.

M. Unit segments shall be customized for installation.

2.3 BASE RAIL

A. Provide a structural base rail under the full perimeter of the unit, formed from mill galvanized steel.

B. Provide clearance for proper external trapping of drain pans.

C. Provide base rail and lifting lug system that does not require additional support for rigging. Include base rail lifting lugs at unit corners.

2.4 UNIT CASINGS

A. General Fabrication Requirements for Casings:

1. Forming: Form walls, roofs, and floors with at least two breaks at each joint.
2. Casing Joints: Sheet metal screws or pop rivets.
3. Sealing: Seal all joints with water-resistant sealant.
4. Provide 2-inch minimum, thermal broke double wall AHU casing. Exposed insulation is not acceptable.
5. Factory Finish for Galvanized-Steel Casings: Castings shall be finished to meet ASTM B117 2,000 hour salt spray test.
6. Panel assembly shall meet UL, Standard 1995 for fire safety. Panel insulation shall comply with the requirements of NFPA 90A.
7. Provide an insulation system that is resistant to mold growth in accordance with a standardized test method such as UL 181 or ASTM C 1338.
8. Encapsulate insulation with sheet metal so that air does not contact insulation. Panels insulated with fiberglass shall be sealed at each corner and around their entire perimeter, to eliminate airflow through the panel and to eliminate microbial growth potential within the casing wall.
9. Provide casing with minimum thermal resistance (R-value) of 13-hour-ft^2-degF/BTU.
10. Roof, wall, floor and access door panels shall be galvanized or stainless steel.
11. Provide a unit frame of galvanized steel that provides the overall structure of the unit and does not rely on the casing panels for structural integrity. Insulate frame in the same manner as panels, roof, and floors.
12. Provide AHU casing that leaks no more than 1% of design airflow at +/-8-inches w.g.
13. The removal of side panels shall not affect the structural integrity of the unit. All removable panels shall be gasketed.

B. Casing Insulation:

1. Materials: 2” Polyurethane Foam.
2. Location and Application: Factory applied with adhesive and mechanical fasteners to the internal surface of section panels downstream from, and including, the cooling-coil section.
   a. Liner Adhesive: Comply with ASTM C 916, Type I.
   b. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service-air velocity.
3. Location and Application: Encased between outside and inside casing.

C. Inspection and Access Panels and Access Doors:

1. Panel and Door Fabrication: Formed and reinforced, double-wall insulated panels of same materials and thicknesses as casing.
2. Inspection and Access Panels:
   a. Fasteners: Two or more camlock type for panel lift-out operation.
   b. Gasket: Neoprene applied around entire perimeters of panel frames.
   c. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.
3. Access Doors:
   a. Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever-type latches, operable from inside and outside.
   b. Gasket: Neoprene, applied around entire perimeters of panel frames.

c. Size: At least 18 inches (450 mm) wide by full height of unit casing up to a maximum height of 72 inches (1800 mm) or largest door possible based on unit size.

4. Locations and Applications:

a. Fan Section: Doors and access panels.
b. Access Section: Doors.
c. Coil Section: Inspection and access panel.
d. Damper Section: Inspection and access panels.
e. Filter Section: Doors large enough to allow periodic removal and installation of filters.
f. Mixing Section: Doors.

D. Condensate Drain Pans:

1. Fabricated with 1.25 percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and to direct water toward drain connection.

a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1-2004.
b. Depth: Triple sloping drain pan with maximum depth of 1.7” and minimum depth of 0.7”.

2. Formed sections or integral part of floor plating.
3. Double-wall, Type 304A, stainless-steel sheet with space between walls filled with 2-inch minimum thickness foam insulation and moisture-tight seal.
4. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
5. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

E. Air-Handling-Unit Mounting Frame: Formed galvanized-steel channel or structural channel supports, designed for low deflection, welded with integral lifting lugs.

2.5 FAN, DRIVE, AND MOTOR SECTION

A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower. Fans shall be direct drive variable speed type using EC motors or premium efficiency motor with variable speed drives.

1. Shafts: Designed for continuous operation at maximum-rated fan speed and motor horsepower, and with field-adjustable alignment.

a. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
b. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

B. Plenum Fan Housings Fan Array System: The fan shall be single width, single inlet multi-blade type. The fan blades shall be backward inclined airfoil. Steel frame and panel; fabricated without fan scroll and volute housing. Provide piezo rings for air flow measuring.

C. Motor: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Enclosure Type: NEMA 1 with VSD and shaft grounding ring.
2. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.15
4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
5. NEMA design ball bearing type.
6. Motors shall be variable speed or variable speed EC motor.

7. Provide door safety interlock with fan motor.

D. Direct drive plenum fans with integral frame motors shall be mounted on isolation bases. Fansh shall be dynamically balanced throughout the operating range per AMCA 204 Test standard. Motor shall be internally isolated with rubber isolators

2.6 COIL SECTION

A. General Requirements for Coil Section:

1. Comply with ARI 410.
2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
3. Provide cooling coils with a maximum face velocity of 550 fpm or 500 fpm or 450 fpm. Face velocity calculations shall be based on the finned area of the coil.
4. Coils shall not act as structural component of unit.
5. Provide panels that are easily removable with no special tools.
6. Locate access doors to provide clearance for pipe insulation, connectors, and accessories. Space shall allow a minimum of 90 degrees of door swing.
7. Provide coils built in their own full perimeter frame or coils shall be supported by the block-off wall and support each other. Tube sheets on each end shall have fully drawn collars to support and protect tubes. Horizontal coil casing and support members shall allow moisture to drain. Casing and support members shall not block finned area.
8. Individual coils shall be removable from the side and/or top panels of the AHU without the need to remove or disassemble the entire section from the unit.
9. Provide a single intermediate vertical coil support on coils with a finned length greater than 62 inches. Provide two vertical supports on coils with a finned length greater than 100 inches, and three vertical supports on coils with a finned length greater than 141 inches.
10. Extend coil connections through AHU casing. Provide a 1/4-inch FPT plugged vent/drain tap on each connection. Circuiting shall allow complete draining and venting when installed. Vent and drain connections shall be on the coil connection extension outside of the unit casing.
11. Insulate gap between coil stub-out connection and AHU casing with a spool shaped sleeve grommet. Adhesive rings applied the casing walls are not acceptable.
12. Water and glycol coils shall be operable at 250 psig working pressure and up to 300 degrees F. Factory test water and glycol coils with 325 psig compressed air under water.
13. All heating coils shall be located in the reheat position, downstream of the cooling coil.
14. All coils shall be rated based on a 35% propylene glycol solution.

B. Water Coils:

1. Certification: Acceptable water coils are to be certified in accordance with ARAI Standard 410 and bear the ARI label. Coils exceeding the scope of the manufacturer's certification and/or the range of ARI's standard rating conditions will be considered provided the manufacturer is a current member of the ARI Air-Cooling and Air-Heating Coils Certification Programs and that the coils have been rated in accordance with ARI Standard 410. Manufacturer must be ISO 9002 certified.
2. Headers shall consist of seamless copper tubing or cast iron to assure compatibility with primary surface. Headers to have intruded tube holes to provide maximum brazing surface for tube to header joint, strength, and inherent flexibility. Header diameter should vary with fluid flow requirements.
3. Fins shall have a minimum thickness of 0.0095" of aluminum plate construction. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes shall not be visible between fins. Use of soldering or tinning during the fin to tube bonding process is not acceptable.
4. Coil tubes shall be 1/2 inch (12.7mm) or 5/8 inch (16mm) OD seamless copper, expanded into fins, brazed at joints. Soldered U-bends shall be provided to minimize the effects of erosion and premature failure having a minimum tube wall thickness of .020".
5. Coil connections shall be N.P.T. threaded carbon steel or threaded red brass with connection size to be determined by manufacturer based upon the most efficient coil circuiting. Vent and drain

fittings shall be furnished on the connections, exterior to the air handler. Vent connections provided at the highest point to assure proper venting. Drain connections shall be provided at the lowest point to insure complete drainage and prevent freeze-up.

6. Coil casings shall be a formed channel frame of stainless steel for cooling coils and galvanized steel for heating coils.

2.7 AIR FILTRATION SECTION

A. General Requirements for Air Filtration Section:

1. Comply with NFPA 90A.
2. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
3. Provide filter holding frames arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side.
4. Provide Class 2 or Class 1 Filter media per UL 900 and as required by local Codes.
5. Provide Dwyer Differential Pressure gauges across each filter bank
6. Provide gasketed holding frame with all joints being airtight.

B. Extended Surface Plated Filters (MERV 13)

1. Four-inch Deep Type:

a. General: Provide 4-inch final filters only where indicated on the Drawings. Air filters shall be 4-inches deep, high efficiency ASHRAE box style filters consisting of mini-pleated wet laid fine fiber media, thermoplastic resin separators, frame to media adhesive and high set strength beverage board enclosing frame. Face velocities shall be as noted on Drawings or other supporting materials.

b. Construction¨ Filter media shall be of one continuous sheet of micro fine wet-laid glass mat filter media formed into uniformly spaced pleats and formed into a mini-pleat pack configuration. Thermoplastic pleat separators shall provide uniform media separation to promote uniform airflow throughout the media. The enclosing frame shall be of high wet strength beverage board which shall be bonded to the entire periphery of the media pack to prevent air bypass. The frame shall include integral diagonal support members to ensure maintained media spacing and pleat stability. The diagonal support members shall be bridge-engineered to prevent filter racking and ensure filter configuration integrity. Filter shall be bi-directional with regard to airflow.

c. Performance: the filter shall have a Minimum Efficiency Reporting Value of MERV 13, or 14, as indicated on the Drawings when evaluated under the guidelines of ASHRAE Standard 52.2-2007. It shall have a MERV-A of 13, or 14 respectively, when tested under Appendix J of that standard. Initial resistance to airflow shall be 0.33”, 0.47”, 0.60”, respectively, w.g. at an airflow of 500 fpm. Filter shall be qualified by Underwriters Laboratories as UL 900, Class 2. Manufacturer shall provide evidence of facility certification to ISO 9001:2000. The filter shall be capable of withstanding 5.0 w.g. without failure of the media pack.

d. Provide ASHRAE product Test Report per ASHRAE Standard 52.2-2007, including testing per Appendix J.

e. Product shall be Camfil Farr Opti-Pac or approved equal.

C. Filter Gauge:

1. 3-1/2-inch- (90-mm-) diameter, diaphragm-actuated dial in metal case.
2. Vent valves.
3. Black figures on white background.
4. Front recalibration adjustment.
5. 2 percent of full-scale accuracy.
6. Range: 0- to 2.0-inch wg (0 to 500 Pa).
7. Accessories: Static-pressure tips with integral compression fittings, 1/4-inch (6-mm) aluminum tubing, and 2- or 3-way vent valves.

8. Flush mounted, factory-installed on drive side of unit to measure pressure drop across each filter bank.

2.8 ADDITIONAL SECTIONS (REFER TO DRAWINGS)

A. Manual section shall be provided by the air handling unit manufacturer as an integral section of the unit for field installation of special components. Section length to be determined by the component supplier or as indicated on the drawings.

B. Inlet and/or discharge plenum section where required shall be provided as the first, last section in the direction of airflow. The plenum shall provide single or multiple top, end, or bottom openings.

F. Refer to drawings for sections and configuration including return air inlet connections and supply air and air outlet connections.

2.9 CAPACITIES AND CHARACTERISTICS

A. Casing:

1. Outside Casing: Galvanized steel, minimum 22 gauge thick.
2. Inside Casing: Galvanized steel, solid, minimum 24 gauge thick.
3. Insulation Thickness: 2 inches (50 mm).
4. Static-Pressure Classifications for Unit Sections before Fans: 6-inch wg (1500 Pa).
5. Static-Pressure Classifications for Unit Sections after Fans: 6-inch wg (1500 Pa).

B. Supply Fan: Refer to Drawings for characteristics.

C. Exhaust, Relief and/or Return Fan: Refer to Drawings for characteristics.

D. Reheat Coil: Refer to Drawings for characteristics.

E. Heating Coil: Refer to Drawings for characteristics.

F. Cooling Coil: Refer to Drawings for characteristics.

G. Prefilters: Refer to Drawings for characteristics.

H. Final Filters: Refer to drawings for characteristics.

I. Dampers: Mixing dampers and/or Face and bypass dampers: As indicated on the Drawings.

J. Airflow Measuring Stations: Integral or remote

2.10 SOURCE QUALITY CONTROL

A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.

B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

C. Water Coils: Factory tested to 300 psig (2070 kPa) according to ARI 410 and ASHRAE 33.

2.11 AUTOMATIC TEMPERATURE CONTROLS

A. Coordinate all automatic Temperature Control (ATC) requirements with Johnson Controls.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Equipment Mounting: Install air-handling unit using elastomeric pads. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Minimum Deflection: 1/4 inch (6 mm).
2. Install galvanized or stainless-steel plate to equally distribute weight over elastomeric pad.

B. Suspended Units: Suspend units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Arrange installation of units to provide access space around air-handling units for service and maintenance.

D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.

E. Install filter-gage, static-pressure taps upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum in accessible position. Provide filter gages on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

F. Install equipment per industry standards, applicable codes, and manufacturer’s instructions.

G. Do not use AHU’s for temporary heating, cooling, or ventilation prior to complete inspection and startup performed per this specification.

H. Install AHU’s on a concrete pad, or structural steel base, as shown on the drawings.

I. Install AHU’s with manufacturer’s recommended clearances for access, coil pull, and fan removal.

J. Provide on complete set of filters for testing, balancing, and commissioning. Provide second comp0lete set of filters at time of transfer to Owner.

K. Install AHU plumb and level. Connect piping and ductwork according to manufacturer’s instructions.

L. Ship units in knock down form and field assemble where required for installation and rigging purposes. The manufacturer shall oversee and approve reassembly in the field.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to air-handling unit to allow service and maintenance. Coordinate access, catwalk locations etc. for easy access to perform service and maintenance (filter replacement, cleaning of coils, replacing fans/fan motors etc.). Do not block access with piping and valving however all valving shall be readily accessible. The contractor shall field review access for service and maintenance of each unit with the owners representative.

C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using NPS 1-1/4 (DN 32) minimum, ASTM B 88, Type M (ASTM B 88M, Type C) copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction. Coordinate requirements with the Plumbing Contractor.

E. Hot- and Chilled-Water Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

F. Connect duct to air-handling units with flexible connections. Comply with requirements in Division 23 Section "Air Duct Accessories."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Technician shall inspect and verify the following as minimum:

   a. Damage of any kind.
   b. Level installation of unit.
   c. Proper reassembly and sealing of unit segments at shipping splits.
   d. Installation of shipped-loose parts, including filters.
   e. Completion and tightness of electrical, ductwork, and piping connections.
   f. Tight seals around wiring, conduit and piping penetrations through AHU casing.
   g. Supply of electricity from the building’s permanent source.
   h. Integrity of condensate trap for positive or negative pressure operation.
   i. Condensate traps charged with water.
   j. Removal of shipping bolts and shipping restraints.
   k. Tightness and full motion range of damper linkages (operate manually).
   l. Complete installation of control system including end devices and wiring.
   m. Cleanliness of AHU interior and connecting ductwork.
   n. Proper service and access clearances.
   o. Proper installation of filters.
   p. Filter gauge set to zero.

2. Resolve any non-compliant items prior to proceeding with the inspection of the fan assembly.

C. Tests and Inspections:

1. Leak Test: After installation, fill water coils with water, and test coils and connections for leaks.
2. Charge refrigerant coils with refrigerant and test for leaks.
3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.

E. Prepare test and inspection reports.

F. Store per AHU Manufacturer's written recommendations. Store AHU's indoors in a warm, clean, dry place where units will be protected from weather, construction traffic, dirt, dust, water, and moisture. If units will be stored for more than 6 months, follow manufacturer's instructions for long-term storage.

G. Rig and lift units according to manufacturer's instructions.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that shipping, blocking, and bracing are removed.
3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
6. Verify that zone dampers fully open and close for each zone.
7. Verify that face-and-bypass dampers provide full face flow.
8. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
9. Comb coil fins for parallel orientation.
10. Verify that proper thermal-overload protection is installed for electric coils.
11. Install new, clean filters.
12. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

B. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions**.**
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

C. AHU Fan Assembly:

1. Fan isolation base and thrust restraint alignment.
2. Tight set screws on pulleys, bearings and fan.
3. Tight fan bearing bolts.

4. Tight fan and motor sheaves.
5. Tight motor based and mounting bolts.
6. Blower wheel tight and aligned to fan shaft.
7. Sheave alignment and belt tension.
8. Fan discharge alignment with discharge opening.
9. Fan bearing lubrication.
10. Free rotation of moving components (rotate manually..

D. Manufacturer shall perform service to bring fan performance within factory specifications.

3.7 CLEANING

A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION

SECTION 23 81 46 - WATER-SOURCE UNITARY HEAT PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes unitary heat pumps (reverse chillers) with refrigerant-to-water heat exchangers, refrigeration circuits, and refrigerant compressor(s).

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each water-source unitary heat pump.
2. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For water-source unitary heat pumps, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Product Certificates: For each type of water-source unitary heat pump, signed by product manufacturer.

C. Field quality-control reports.

D. Sample Warranty: For manufacturer's warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water-source unitary heat pumps to include in emergency, operation, and maintenance manuals.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of water-source unitary heat pumps that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, refrigeration components.
2. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance:

1. ASHRAE 15.

B. Comply with NFPA 70.

C. Comply with safety requirements in UL 484 for assembly of free-delivery, water-source heat pumps.

2.2 WATER-SOURCE UNITARY HEAT PUMPS LARGER THAN 6 TONS (21 kW)

A. Unit manufacturer shall be Water Furnace or equal, Climate Masters or Trane.

B. Description: Packaged water-source unitary heat pump with temperature controls; factory assembled, piped, wired, tested, and rated according to ASHRAE/ARI/ISO-13256-1. Water to water heat pumps shall be capable of working in the mechanical cooling mode while rejecting heat to the heating water loop or operating in the heating mode by absorbing heat out of the chilled water loop. The BAS shall be capable of enabling the cooling mode or the heating mode of operation as well as adjusting cooling and heating supply water setpoints when operating in those modes.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency and marked for intended location and application.

C. Cabinet and Chassis: Galvanized-steel casing with the following features:

1. Access panel for access and maintenance of internal components.
2. Knockouts for electrical and piping connections.
3. Cabinet Insulation: Glass-fiber liner or closed cell, minimum 3/4 inch (19 mm) thick, complying with UL 181, ASTM C1071, and ASTM G21.

D. Water Circuits:

1. Refrigerant-to-Water Heat Exchangers:
   a. Brazed plate type heat exchangers, dual refrigerant circuits with a single water circuit, with 316 stainless steel plates and cupro-nickel braze material capable of withstanding 650 psig working pressure on the refrigerant side and 450 psig on the water side. The heat exchanger Heat exchangers are to be insulated with ¾" inch thick, 0.27 BTU-in/hr sq.ft.

thermal conductivity, expanded closed-cell foam insulation. The insulation shall be manufactured without the use of CFC's or HFC's. Provide access for cleaning.

E. Refrigerant Circuit Components:

1. Sealed Refrigerant Circuit: Charge with R-454B refrigerant.
2. Filter-Dryer: Factory installed to clean and dehydrate the refrigerant circuit.
3. Charging Connections: Service fittings on suction and liquid for charging and testing on each circuit.
4. Reversing Valve: Four-way, solenoid-activated valve designed to be fail-safe in heating position with replaceable magnetic coil.
5. Compressor:

    a. Scroll.
    b. Installed on vibration isolators and mounted on a structural steel base plate and full-length channel stiffeners.
    c. Exterior of compressor shall be wrapped with a high-density sound-attenuating blanket and housed in an acoustically treated enclosure.
    d. Factory-Installed Safeties:

        1) Antirecycle timer.
        2) High-pressure cutout.
        3) Low-pressure cutout or loss of charge switch.
        4) Internal thermal-overload protection.
        5) Freezestat to stop compressor if water-loop temperature in refrigerant-to-water heat exchanger falls below 35 deg F (2 deg C).
        6) Water-coil, low-temperature switch.

6. Refrigerant Piping Materials: ASTM B743 copper tube with wrought-copper fittings and brazed joints.
7. Pipe Insulation: Refrigerant minimum 3/8-inch- (10-mm-) thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-developed indexes according to ASTM E84.
8. Refrigerant Metering Device: Thermal-expansion valve.
9. Refrigerant Metering Device: Dual-port, thermal-expansion valve to allow specified operation with entering-water temperatures from 30 to 9 deg F.

F. Controls: (BACNET MSTP)

1. Basic Unit Control Modes and Devices:

    a. Unit shutdown on high or low refrigerant pressures.
    b. Unit shutdown on low water temperature.
    c. Low- and high-voltage protection.
    d. Overcurrent protection for compressor.
    e. Random time delay, three to 10 seconds, start on power-up.
    f. Time delay override for servicing.
    g. Control voltage transformer.
    h. Water-coil freeze protection (selectable for water or antifreeze).
    i. Automatic intelligent reset. Unit shall automatically reset five minutes after trip if the fault has cleared. Should a fault reoccur three times sequentially, lockout requiring manual reset occurs.
    j. Ability to defeat time delays for servicing.
    k. Digital display to indicate high pressure, low pressure, low voltage, and high voltage.
    l. The low-pressure switch shall not be monitored for the first 90 seconds after a compressor start command to prevent nuisance safety trips.
    m. Remote fault-type indication at thermostat.
    n. Selectable 24-V dc or pilot duty dry contact alarm output.
    o. 24-V dc output to cycle a motorized water valve with compressor contactor.
    p. Service test mode for troubleshooting and service.

q. Unit-performance sentinel warns when heat pump is running inefficiently.
r. Compressor soft start.

2. DDC interface requirements.

a. Provide BAC-net interface for central Johnson Controls BAS for the following minimum functions:

1) Set-point adjustment
2) Start/stop and operating status of heat-pump unit.
3) Data inquiry to include supply-air and room-air temperature and humidity, and entering-water temperature.
4) Occupied and unoccupied schedules.
5) Determine heating or cooling mode of operation
6) Provide heating and cooling supply water temperature setpoints
7) All points shall integrate into the EMS.

b. Refer to the control drawings for the sequence of operation and coordinate unit controller and sequence of operation for the indicated controllable modes (cooling priority, heating priority) and associated controllable setpoint temperatures in both cooling priority and heating priority modes through the Johnson Controls BAS in a fully turnkey fashion. The unit shall be capable of providing mechanical cooling (cooling priority) while rejecting heat to the low temperature heating loop or provide heating (heating priority) while absorbing heat from the chilled water loop.

G. Electrical Connection: Single electrical connection with fused disconnect.

H. Capacities and Characteristics: Refer to schedule on drawings

2.3 ACCESSORIES

A. Hose Kits: Tag hose kits to equipment designations.

1. Minimum Working Pressure: 400 psig (2758 kPa).
2. Operating Temperatures: From 33 to 211 deg F (1 to 100 deg C).
3. Hose Length: 36 inches (900 mm).
4. Minimum Hose Diameter: Equal to water-source unitary heat-pump piping connection.
5. Hose Material: Braided stainless steel with adapters for pipe connections.
6. Isolation Valves: Two-piece, bronze-body ball valves with stainless-steel ball and stem, full-port threaded connections, and galvanized-steel lever handle. Valves shall be factory installed on supply and return connections of both load-side and source-side heat exchangers. If balancing valve is combination shutoff type with memory stop, the isolation valve may be omitted on the return.
7. Strainer: Y-pattern with blowdown valve in supply connections of both load and source side of heat exchangers.

B. Flow switch (or differential pressure switch)

C. Compressor sound blankets

D. Refrigerant pressure gauges

E. Phase Protection

F. Fuses and disconnect switch

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping and electric installations for water-source unitary heat pumps to verify actual locations of piping connections and electrical conduits before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Equipment Mounting:

1. Install water-source, unitary heat pumps on cast-in-place concrete equipment base(s) a minimum of 6 inches thick.

B. Controls: integrate controls into the Building Automation System (BAS) in a fully turnkey fashion. Coordinate requirements with the ATC contractor (Johnson Controls).

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Connect supply and return hydronic piping to heat pump with hose kits.

B. Install electrical devices furnished by manufacturer but not specified to be factory mounted.

C. Install piping adjacent to machine to allow space for service and maintenance.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following field tests and inspections:

1. After installing water to water heat pumps and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Heat pumps will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Inspect for visible damage to unit casing.
3. Inspect for visible damage to compressor and coils.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Adjust vibration isolators.
9. Start unit according to manufacturer's written instructions.
10. Complete startup sheets and attach copy with Contractor's startup report.
11. Inspect and record performance of interlocks and protective devices; verify sequences.
12. Operate unit for an initial period as recommended or required by manufacturer.
13. Verify thermostat calibration.
14. Inspect controls for correct sequencing of heating, refrigeration, and normal and emergency shutdown.

3.6 ADJUSTING

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: provide on-site assistance adjusting system in both the cooling and the heat mode of operation within twelve months of substantial completion.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to start up and train Owner's maintenance personnel to adjust, operate, and maintain water-source unitary heat pumps.

END OF SECTION 238146

SECTION 26 05 01 - GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL

A. Provide all labor, materials, equipment and services necessary for and incidental to the complete installation and operation of all electrical work.

B. All work under this Division is subject to the General Conditions and Special Requirements for the entire contract.

C. Unless otherwise specified, all shop drawings and submissions required under Division 26 shall be made to, and acceptances and approvals made by, the ENGINEER.

D. Conform to the requirements of all rules, regulations, and codes of local, state, and federal authorities having jurisdiction. Conform to the National Electrical Code and all NECA – National Electrical Installation Standards (NEIS).

E. Perform the work in a first-class, substantial, and workmanlike manner. Any materials installed which do not present an orderly and neat workmanlike appearance shall be removed and replaced when so directed by the Engineer, at the Contractor's expense.

F. Coordinate the work of all trades.

G. Arrange conduit, wiring, equipment, and other work generally as shown, providing proper clearances and access. Carefully examine all contract drawings and fit the work in each location without substantial alteration. Where departures are proposed because of field conditions or other causes, prepare and submit detailed drawings for approval in accordance with “Submittals” specified below. The right is reserved to make reasonable changes in location of equipment, conduit, and wiring up to the time of rough-in or fabrication.

H. The contract drawings are generally diagrammatic and all offsets, bends, fittings, and accessories are not necessarily shown. Provide all such items as may be required to fit the work to the conditions.

I. Be responsible for all construction means, methods, techniques, procedures, and phasing sequences used in the work. Furnish all tools, equipment and materials necessary to properly perform the work in a first class, substantial, and workmanlike manner, in accordance with the full intent and meaning of the Contract Documents.

J. The Contractor shall provide other work and services not otherwise included in the Contract Documents that are customarily forwarded in accordance with generally-accepted construction practices.

1.3 PERMITS, INSPECTIONS, AND FEES:

A. The Contractor shall obtain and pay for all charges and fees, and deliver all permits, licenses, certificates of inspection, etc., required by the authorities having jurisdiction. Deliver inspection, approval, and other certificates to the Owner prior to final acceptance of the work.

B. File necessary plans, prepare documents, give proper notices, and obtain necessary approvals.

C. Permits and fees shall comply with the General Requirements of the Specification.

D. Notify Inspection Authorities to schedule inspections of work. All work shall be subject to field inspections.

E. Notify Architect in advance of scheduled inspections.

F. An electrical foreman, superintendent or other supervisor shall be in attendance for all scheduled inspections.

G. The Contractor shall provide an electrical certificate from an independent electrical inspection agency approved by the Owner and the State of Pennsylvania Fire Marshal. The Contractor shall submit certificate prior to final payment invoice. The Contractor shall pay all fees, including filing fees.

1.4 ELECTRICAL WORK UNDER OTHER DIVISIONS:

A. Mechanical Equipment and Systems

1. In general, power wiring and motor starting equipment for mechanical equipment and systems are furnished and installed under Electrical Division 26.

2. Certain mechanical units contain starters, contacts, transformers, fuses, wiring, etc., required for fans, pumps, etc., furnished with the equipment from the factory. When this equipment is supplied from the factory, the Contractor must supply power circuit(s) to the unit and a disconnecting means. Coordinate with Contractor so that one, and only one, set of starters, fuses, switches, etc., is provided and installed.

3. In general, control and interlock equipment for HVAC systems (including associated wiring, conduit, transformers, relays, contacts, etc.) is furnished under Mechanical Division 23. Contractor shall install and connect all such equipment as necessary.

4. Controls, wiring, conduit, transformers, etc., for smoke, fire, and motor-operated dampers are provided by Mechanical. Electrical shall install and connect all such equipment.

B. Carefully review the contract documents and coordinate the electrical work under the various Divisions.

1.5 CONTRACTOR QUALIFICATION:

A. Any Contractor performing work under this Division shall be fully qualified and acceptable to the Engineer. Submit the following evidence for approval:

1. A list of not less than five (5) comparable projects that the Contractor completed.

2. Letters of reference from not less than three (3) registered professional engineers, contractors, or building owners, explaining Contractor proficiency, quality of work, or other attribute on projects of similar size or substance.

3. Local or State license.

4. Membership in trade or professional organization where required.

5. Copy of Master Electrician's License.

B. Contractor is any individual, partnership, corporation, or firm performing work by Contract or subcontract on this project.

C. Acceptance of a subcontractor will not relieve the Contractor of any contractual requirements or his responsibility to supervise and coordinate the various trades.

D. Supervisory Qualifications: The electrical work on the project shall be under the direct supervision of a licensed Master Electrician.

E. Qualifications of Installers:

1. For the actual fabrication, installation, and testing of the work, the Contractor shall use only thoroughly trained and experienced personnel who are completely familiar with the requirements of this work and with the installation recommendations of the manufacturers of the specified items.

2. The Electrical Installer shall utilize a full time project foreman in charge of all electrical work. This person shall be fully qualified and experienced in such work and shall be available, on site, at all times during Construction. All problems, questions, coordination, etc., relating to electrical work shall take place through this person to the Architect.

F. Qualifications of Video Tape Technician: For videotaping specified in "Operating Instructions", the Contractor shall provide the services of persons skilled in videotape production and editing.

1.6 FIRE SAFE MATERIALS:

A. Unless otherwise indicated, materials and equipment shall conform to UL, NFPA, or ASTM Standards for Fire Safety with Smoke and Fire Hazard Rating not exceeding flame spread of 25 and smoke developed of 50.

1.7 REFERENCED STANDARDS, CODES, ORDINANCES AND SPECIFICATIONS

A. Specifications, Codes and Standards listed below are included as part of this specification, latest edition.

ADA	Americans with Disabilities Act
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
PECO	Philadelphia Electric Company
IBC	International Building Code
CABO	Council of American Building Officials
FM	Factory Mutual
IEEE	Institute of Electrical and Electronics Engineers
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety & Health Administration
UL	Underwriters Laboratories

B. All electrical equipment and materials shall comply with the Codes and Standards listed in the latest edition of IEEE Standard 241, *Electric Power Systems in Commercial Buildings*, Chapter 1, Section 1.6, entitled “Codes and Standards”.

C. Comply with all Codes applicable to the work:
1. Bidders shall inform themselves of all local and state codes and regulations.
2. In case of conflict between Contract Documents and governing Codes, the most stringent shall take precedence. Where, in any specific case, different sections of any applicable codes or when Drawings and Specifications specify different materials, methods of Construction, or other requirements, the most restrictive shall govern.
3. Where Contract Documents exceed minimum Code requirements, and are permitted under the Code, the Contract Documents take precedence and shall govern.
4. No extra payment will be allowed for work or changes required by local Code enforcement authorities.

D. Underwriters Laboratories Labels shall apply to all materials and devices, etc., except specified items not covered by existing UL Standards.

E. Conflicts with applicable regulations:
1. Resolve at Contractor’s expense.

2. Prepare and submit details of alternate construction:
   a. Acceptable solution of conflict.
   b. List of substitute materials:
      For approval of inspecting authorities.
      For approval of Engineer.

F. Comply with all NECA's National Electrical Installation Standards (NEIS), including NECA 1-2000 "Standard Practices for Good Workmanship in Electrical Contracting".

1.8 INTERPRETATION OF DOCUMENTS

A. Any discrepancies between Drawings, Specifications, Drawings and Specifications, or within Drawing and Specifications shall be promptly brought to the attention of the Owner during the bidding period. No allowance shall subsequently be made to the Contractor by reason of his failure to have brought said discrepancies to the attention of the Owner during the bidding period or of any error on the Contractor's part.

B. The locations of products shown on Drawings are approximate. The Contractor shall place the devices to eliminate all interference with above-ceiling ducts, piping, etc. Where any doubt exists, the exact location shall be determined by the Owner.

C. All general trades and existing conditions shall be checked before installing any outlets, power wiring, etc.

D. Equipment sizes shown on the Drawings are estimated. Before installing any wire or conduit, the Contractor shall obtain the exact equipment requirements and install wire, conduit, or other item of the correct size for the equipment actually installed. However, wire and conduit sizes shown on the Drawings shall be taken as a minimum and shall not be reduced without written approval from the Owner.

E. Where variances occur between the drawings and specifications or within either document itself, the item or arrangement of better quality, greater quality, or higher cost shall be included in the Contract Price. The Engineer will decide on the item and manner in which the work shall be installed.

F. Contract Drawings are generally diagrammatic and all offsets, fittings, transitions, and accessories are not necessarily shown. Furnish and install all such items as may be required to fit the work to the conditions encountered. Arrange conduits, equipment, and other work generally as shown on the Contract Drawings, providing proper clearance and access. Where departures are proposed because of field conditions or other causes, prepare and submit detailed Shop Drawings for approval in accordance with "submittals" specified below. The right is reserved to make reasonable changes in location of equipment, piping, and ductwork, up to the time of rough-in or fabrication.

G. Work not specifically outlined, but reasonably incidental to the completion of the work, shall be included without additional compensation from the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Material and equipment installed as a part of the permanent installation shall be new, unless otherwise indicated or specified, and shall be approved by the Underwriters' Laboratories, Inc., for installation in each particular case where standards have been established.

B. Where material or equipment is identified by proprietary name, model number, and/or manufacturer, furnish the named item or equivalent thereof, subject to acceptance.

C. Material submissions shall conform to requirements outlined in SUBMITTALS, REVIEW, AND ACCEPTANCE.

D. The suitability of named item only has been verified. Where more than one Manufacturer is named, only the first named Manufacturer has been verified as suitable alternate. Manufacturers and items other than the first named shall be equal or better in quality and performance to that of specified items, and must be suitable for available space, required arrangement, and application. Submit all data necessary to determine suitability of alternate manufacturers for review. Provide a list company proposed and specified products and performance on the first page of the submittal. Failure to clearly identify differences will result in the submittal being returned as "Revise

and Resubmit". The Contractor, by providing other than the first named Manufacturer, assumes responsibility for all necessary adjustments and modifications necessary for a satisfactory installation.

E. The Contractor shall only submit those manufacturers indicated in the Specification. Proposed manufacturers other than those indicated will not be considered unless the specific item indicates "or as approved equal". Submit all data necessary to determine suitability of substituted items for approval. Failure to do so will result in a "Revise and Resubmit" response.

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F. All items of equipment furnished shall have a service record of at least five (5) years.

2.2 SUBSTITUTIONS

A. Substituted items or items other than those named shall be equal or better in quality and performance and must be suitable for the available space, required arrangement, and application. Submit any and all data necessary to determine the suitability of substituted items. The Contractor shall be responsible for correct application, placement, and installation of substituted equipment. Cost savings data shall also be submitted with submittal data for substituted items. Total cost savings or a per-unit saving to the Owner shall be clearly indicated. If a substituted item is accepted, all cost savings shall be returned to the Owner as a credit.

B. Substitutions will not be permitted for specific items of material or equipment where specifically indicated.

C. For substituted items, clearly list on the first page of the submittal all differences between the specified item and the proposed item. The Contractor shall be responsible for corrective action (or replacement with the specified item) while maintaining the specification requirements if differences have not been clearly indicated in the submittal.

D. Where the Contractor proposes to use an item of equipment or application other than that specified or detailed on the Drawings, which requires any redesign of the structure, partitions, foundation, HVAC, piping, wiring, or any other part of the mechanical, electrical, or architectural layout, all such redesign and all new drawings and detailing required thereafter shall be prepared by the Contractor at his own expense for review by the Owner representative before any such work is implemented.

E. All Contractor-proposed changes and revisions shall be at the Contractor's risk and expense. The Contractor shall fully coordinate all revisions, substitutions and changes with other trades. The Contractor shall provide all necessary provisions, including HVAC, ventilation, foundations, access, etc., for a complete, code compliant, and fully functional installation.

F. Where the Contractor elects to submit a substitution for equipment or materials, he shall:

1. Submit Shop Drawings that show complete compliance to each statement or requirement of the Specifications.

2. Submit certified test data from an independent testing laboratory for each product.

3. Submit one complete working sample of the equipment or materials to be furnished. In cases involving large or heavy items of equipment, the Owner may waive the requirement to submit the sample.

G. Failure to comply with the above-required submissions shall constitute an automatic rejection of the substitution.

2.3 SUBMITTALS, REVIEW, AND ACCEPTANCE

A. General:

1. The equipment, material, installation, workmanship, arrangement of work, final instruction, and final documentation is subject to review and acceptance. No substitution will be permitted after acceptance of equipment or materials except where such substitution is considered by the Engineer to be in the best interest of the Owner. Submit for review in clear and legible form the following documents:
   a. Material and Equipment List
   b. Descriptive Data
   c. Shop Drawings
   d. Installation and Coordination Drawings
   e. Contractor As-Built Drawings

f. Owner Instructions and Manuals
g. Construction Phasing and Outage Schedule

2. Prepare all submittals specifically for this project and stamp each submittal in a form indicating that the documents have been Contractor reviewed, are complete, and are in compliance with the requirements of the plans and specifications. Each submittal item shall be clearly identified and numbered. Each submittal shall contain a complete schedule of Manufacturer's part numbers and quantity listings of all supplied components. Each proposed item shall be highlighted and tagged with a star, an arrow, etc., including all options and accessories.
3. Coordinate the installation requirements and any mechanical requirements for the equipment submitted. Submittals will be reviewed for general compliance with design concept in accordance with the contract documents. The Contractor is responsible for the correctness of all submittals. Reviews will not verify dimensions, quantities, or other details.
4. Identify all submittals, indicating the intended application, location, or service of the submitted item. Refer to specification sections or paragraphs where applicable. Clearly indicate the exact type, model number, size, and special features of the proposed item. Clearly list on the first page of the Submittal all differences between the specified item and the proposed item. The Contractor shall be responsible for corrective action (or replacement with the specified item) while maintaining the specification requirements, if differences have not been clearly indicated in the submittal. Submittals of a general nature will not be acceptable.
5. Submit actual operating conditions or characteristics for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable. Indicate all options used to meet the specifications. It is not the responsibility of the Engineer or Owner to make selections of factory options other than colors. Submittals lacking proper selection of factory options or special features required by the specification shall be RETURNED WITHOUT REVIEW.
6. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted.
7. Documents of general form indicating options shall be clearly marked to show what is specifically proposed for this project.
8. Submittals NOT IN COMPLIANCE with the requirements of this section will be RETURNED WITHOUT REVIEW.

B. Material, Equipment, Manufacturer and Subcontractor List: Within 30 calendar days after the award of contract, submit a complete MATERIAL, EQUIPMENT, MANUFACTURER AND SUBCONTRACTOR LIST for preliminary review. List all proposed materials and equipment, the associated proposed Manufacturer, and any proposed subcontractors. After the receipt of reviewed Material and Equipment List, submit complete Shop Drawings for approval. List all materials and equipment, indicating manufacturer, type, class, model, curves, and other general identifying information. Submittals shall be specific for each building as contained in the individual building Specifications and Drawings.

C. Upon approval of the List of Materials, the Contractor shall prepare a complete Master Submittal Register, listing all products and materials that will be submitted for approval. Items shall be listed by referenced specification paragraph in ascending order. This master list shall be included with each submittal, updated to reflect the status of approval for each item, and shall highlight the items pertaining to the submittal. A suggested Submittal Register Format is shown below:

SUBMITTAL REGISTER					
Item/Material	Ref'd Spec. Paragraph	Specified or Substitute	Submittal Date	Status	Remarks

D. No Shop Drawing Submittals will be considered for approval until the complete List of Subcontractors and the complete List of Materials/Manufacturers and Equipment have been approved.

E. Descriptive Data: After acceptance of the MATERIAL and EQUIPMENT LIST, submit additional DESCRIPTIVE DATA for all items. Data shall consist of specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, installation instructions, and any other

information necessary to indicate complete compliance with the contract documents. Where several ratings or sizes are shown or available, clearly indicate the exact size or rating relating to the particular device being proposed.

F. Submit complete descriptive data for all items. Data shall consist of Specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, wiring diagrams, specific electrical/wiring requirements and connections including control and interlock wiring, installation instructions, and any other information necessary to indicate complete compliance with the Contract Documents. Edit submittal data specifically for application to this project.

G. Shop Drawings shall be submitted and approved for all materials and equipment prior to installation. If any material and/or equipment is installed prior to receipt by the Contractor of approved Shop Drawings, the Contractor is liable for its replacement at no additional cost to the Owner.

H. Data submitted shall include information on all materials and equipment to demonstrate compliance with the Contract Drawings and Specifications. Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

I. Any deviation of submitted material or equipment from the Contract Drawings or Specifications shall be clearly marked in red ink on Submittals, and itemized in a transmittal letter, in order to receive consideration for approval.

J. Approval of material or equipment submittals containing deviations not specifically identified by Contractor shall not relieve the Contractor from compliance with specified requirements.

K. All major items of mechanical equipment shall be the latest standard catalog products of reputable manufacturers. Where two (2) or more items of the same kind of equipment are required, they shall be the products of a single manufacturer.

L. Thoroughly review and stamp all submittals to indicate compliance with Contract requirements prior to submission. Coordinate installation requirements and any electrical requirements for equipment submitted. Contractor shall be responsible for correctness of all submittals.

M. Submittals will be reviewed for general compliance with design concept in accordance with Contract Documents, but dimensions, quantities, or other details will not be verified.

N. Increase, by the quantity listed below, the number of electrical related Shop Drawings, product data, and samples submitted, to allow for required distribution plus two copies of each submittal required, which will be retained by the Electrical Consulting Engineer.

1. Shop Drawings - Initial Submittal: 1 additional blue- or black-line print.
2. Shop Drawings - Final Submittal: 1 additional blue- or black-line print.
3. Product Data: 1 additional copy of each item.

O. Additional copies may be required by individual sections of these Specifications.

P. Shop Drawings:

1. Prepare and submit SHOP DRAWINGS AND/OR DIAGRAMS for all specially fabricated items, modifications to standard items, specially designed systems where detailed design is not shown on the contract drawings, or where the proposed installation differs from that shown on the contract drawings.
2. Shop drawings shall include plans, elevations, sections, mounting details of component parts, point to point interconnection diagrams, elementary diagrams, single line diagrams, and any other drawings necessary to show the fabrication and connection of the complete item or system.
3. Shop drawings shall be provided for, but not limited to the following items:

   Access Doors
   Basic Electrical Materials
   Cable - 600 volt
   Circuit Breakers

Conduit
Contractor and Subcontractor Qualifications
Controllers & Control Devices
Disconnects
Electrical Connection Coordination Schedule
Emergency Generator
Equipment Connections
Fire Alarm Systems
Firestopping
Fuses
Identification System
Lighting Features
Low Voltage Fuses
Motor Starters
Outlet Boxes
Panelboards
Receptacles
Safety Switches
Schedule of Values
Sleeves, Hangers, Supports
Switchboard
Tests and Reports
Transformers
Underground Cable
Wiring Devices
Wiring Diagrams

Q. The Contractor, additionally, shall submit for approval any other shop drawings as required by the Architect/Engineer. No item listed above shall be delivered to the site, or installed, until approved. After the proposed materials have been approved, no substitution will be permitted except where approved by the Engineer.

R. The Contractor shall prepare and submit a Detail Schedule of Values indicating the Contract costs for the major work items. The Contractor shall provide additional detail and information as requested by the Engineer.

S. The Contractor shall prepare and submit a complete Submittal Schedule. The Schedule shall include a listing of all Submittals, Shop Drawings, and Coordination Drawings.

2.4 COORDINATION DRAWINGS:

A. Prepare, submit, and use composite installation and coordination drawings to assure proper coordination and installation of the work. Drawings shall include, but not be limited to the following:
   1. Electrical Rooms indicating switchboard assemblies, transformers, equipment pads, panels, etc.
   2. Mechanical Equipment Rooms, including panels, transformers, starters, equipment, etc.

B. Draw plans to a scale not less than 1/4 inch equals one foot. Include plans of the proposed work, showing all equipment, major elements, conduit, and wiring in the areas involved. Fully dimension all work, horizontally and vertically. Show coordination with other work including piping, ductwork and other mechanical work, walls, doors, ceilings, columns, beams, joists, and other architectural and structural work.

C. Identify all equipment and devices on wiring diagrams. Where field connections are shown to factory-wired terminals, furnish manufacturer's literature showing internal wiring.

D. Prepare, submit, and use scaled layout drawings indicating dimensions, clearances, and actual equipment dimensions. Layout drawing shall include, but not be limited to the following:
   1. Pad-mounted equipment and equipment connections.
   2. Underground conduits, ductbanks, manholes, handholes, and building penetrations.

2.5 RECORD DRAWINGS:

A. As the work progresses, record on a set of white prints the installed locations, sizes of electric feeders, equipment, etc. Upon completion of the work, submit one (1) complete set of white prints with "As-Built"

information neatly recorded thereon in red ink. Use other colors to distinguish between variations in separate categories of the work. Note related change-order numbers where applicable.

B. Write step-by-step detailed instructions for turn-on, turn-off, seasonal changeover, and periodic checks of all systems and equipment. Include all precautions and warnings.

C. Prepare a list of the manufacturers of all major equipment, their local service representative and procedures for obtaining service.

D. Post one (1) copy of all instructions, lists, charts, and diagrams at the equipment or where indicated, mounted under glass or approved plastic cover.

E. Furnish to the Owner two (2) copies of the Manufacturer's installation and operations instructions. Include replacement parts lists where applicable. Also include copies of all posted instructions, lists and charts. Assemble the material in one or more heavy duty 8- 1/2" x 11" loose leaf binders with tab separators. Submit for approval before final delivery. Binder shall be labeled on spine and on cover with Project Name.

F. Deliver all instruction materials to the Owner prior to the formal instruction period.

G. Deliver two (2) complete sets of all approved submittals to the Owner for filing.

H. Prepare record documents in accordance with the requirements in the specifications. In addition to the requirements specified, indicate installed conditions for:

1. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and circuit breaker size and arrangements.
2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
3. Approved Substitutions, Contract Modifications, and actual equipment and materials installed.

I. The Contractor shall keep at the site at all times during construction, one set of up-to-date Contract prints for the express purpose of showing any and all changes made during construction. The Contractor shall make the prints showing each change and shall incorporate all changes in “Record/As-Built Drawings” to be submitted to the Engineer upon completion of the project.

J. The Contractor shall show proof of up-to-date record drawings to the Owner prior to submitting monthly invoice.

K. The Contractor shall conform to all drawings, including all revisions, addendums, alternates, change orders, deletions, existing conditions, and as-built conditions without extra cost to the Owner.

2.6 DEMONSTRATION AND OPERATING INSTRUCTIONS

A. Furnish the necessary technicians, skilled workers, and helpers to operate the electrical systems and equipment of the entire project. The Contractor shall provide a minimum of eight (8) hours of system demonstration and eight (8) hours of system operation for each system.

B. Where specified in technical sections, provide longer periods required for specialized equipment.

C. Contractor shall provide start-up of all systems in an orderly, organized, and coordinated manner to ensure that all systems are functioning as designed. The Contractor shall provide a detailed start-up, testing, and demonstration plan for all systems in a coordinated manner that is documented in writing at least 45 days prior to system start-up. Start-up, testing and demonstration plans shall include detailed point-by-point checklists that clearly show that systems are, in fact, functioning as designed. Instruct the Owner or designated personnel in operation, maintenance, lubrication, and adjustment of systems and equipment.

D. The Operating and Maintenance Manual shall be available at the time of the instructions, for use by Instructors and Owner personnel.

E. Videotape each instruction session, including both the sessions specified above and added sessions required in technical sections for specialized equipment. Provide one complete set of DVD video disks with each Operating and Maintenance Manual.

F. Schedule the general and specialized instruction periods for a time agreed upon by he Owner and Engineer. All operation training and demonstrations shall be complete prior to Owner acceptance of any given system.

PART 3 - EXECUTION

3.1 EXAMINATION OF SITE, SURVEYS, AND MEASUREMENTS:

A. Examine the site, determine all conditions and circumstances under which the work must be performed, and make all necessary allowances for same. No additional cost to the Owner shall be permitted for Contractor's failure to do so.

B. Examine the site and observe the conditions under which the work will be done or other circumstances which will affect the contemplated work. No allowance will be made subsequently in this connection for any error or negligence on the Contractor's part.

C. The Contractor shall base all measurements, both horizontal and vertical, from established benchmarks. All work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the work.

D. Any discovery of discrepancy between actual measurements and those indicated which prevents following good practice or the intent of the Drawings and Specifications shall be brought to the attention of the Owner's Representative. Work shall not proceed until receiving instructions from the Owner's Representative.

E. The Contractor shall follow Drawings in laying out the work and check Drawings of other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions at all points. Where headroom or space conditions appear inadequate, the Owner's Representative shall be notified before proceeding with the installation.

F. To prevent conflict with the work of other trades and for proper execution of the work, the Contractor, as directed by the Owner's Representative, shall make the necessary modifications in the layout as needed, at no extra charge to the Owner.

G. The Contractor shall be solely responsible for the proper arrangement of his conduit and equipment.

H. The Engineer shall make all final decisions as to any conditions that require the changing of any work.

I. The Contractor shall have competent supervision on the site at all times to lay out, check, coordinate, and supervise the installation of all electrical work and be responsible for the accuracy thereof. He shall plan the installation of all electrical work, giving consideration to the work of other trades, to prevent interference.

J. The Contractor shall determine the location, size, etc., of all chases, sleeve openings, etc., required for the proper installation of the electrical work and see that such are provided. All chases, sleeves, openings, etc., shall be set prior to erection of new work to prevent delay in the progress of other work or trades.

K. Conditions and/or situations that prevent the proper installation of any equipment or item where shown on the Drawings shall be called to the attention of the Engineer for instructions.

L. The Contractor shall have equipment shipped or fabricated in sections of suitable size for entering the building and being removed from the finished building in the future, if necessary.

M. The Contractor shall fully investigate all peculiarities and space limitations for all materials and equipment.

N. Outlet, pull, and junction boxes and other appliances that require operation, examination, adjustment, servicing or maintenance shall be readily accessible.

O. The Contractor shall take all field measurements necessary for this work and shall assume responsibility for their accuracy.

P. The Contractor shall coordinate the electrical work with all other sub-contractors. All work shall be so arranged that there will be no delay in the proper installation and completion of any part or parts of electrical equipment. All electrical work shall be installed in proper sequence with other trades without any unnecessary delay.

Q. The Drawings are to some extent diagrammatic and indicate the general arrangement of the equipment, the runs of conduit, and the manner of connection.

R. The Contractor shall confer with all sub-contractors engaged in the construction of the project, regarding the work that may, in any way, affect his installation. Whenever interference occurs, before installing any of the work in question, the Contractor shall consult with all sub-contractors and shall come to an agreement with them as to the exact location and level of his conduit parts of his equipment.

S. The Contractor shall be responsible for determining exact property lines and area of work. The Contractor shall not install any equipment or conduits outside of the property lines and/or area of work without written direction from the Owner. Any work indicated diagrammatically on the Contract Documents to be installed beyond the property lines and/or area of work shall be verified with the Owner prior to installation.

3.2 GENERAL RESPONSIBILITIES:

A. The Contractor shall be responsible for systems and related damages possible, and shall hold harmless the Owner, the Architect/Engineer and his consultants from malfunction of systems and equipment installed under this Contract as defined in the laws of the State of Pennsylvania pertaining to real property for the period of time as defined by such laws.

B. It is the intent of these Specifications to fully cover without exception all required labor and materials so that the finished work will be delivered to the Owner in a complete and satisfactory working installation. Excavation, wiring, distribution, etc., shall be performed in compliance with the Contract Documents.

C. Work not specifically outlined, but reasonably incidental to the completion of the work, shall be included without additional compensation from the Owner.

D. Conflicting points in the Specifications or on the Drawings shall be called to the attention of the Architect/Engineer prior to the execution of the Contract.

3.3 STORAGE AND PROTECTION OF EQUIPMENT

A. All electrical equipment to be used in the construction shall be properly stored and protected against the elements. All equipment shall be stored under cover, and shall not be stored at the construction site on the ground, in mud, water, snow, rain, sleet or dust. Large diameter cables may be stored on reels with weatherproof materials. Such weatherproof materials shall be heavy-duty, securely fastened and made impervious to the elements.

B. Conventional electrical construction materials such as building wire, outlet and junction boxes, wiring devices, conduit, lighting fixtures, fittings, etc., shall be stored in construction buildings, covered trailers or portable covered warehouses. Any equipment subject to damage or corrosion from excessive moisture shall be stored in dry, heated areas. Any equipment containing plastic or material subject to damage caused by excessive heat or sunlight shall be stored to prevent such damage. This includes plastic ducts and lenses.

C. Panelboards, breakers, emergency lighting, and supervisory equipment, if delivered to the construction site before the building is under cover, shall be warehoused and protected as follows: All gear and equipment shall be covered and protected from the elements and other damage and shall be stored in a clean, dry, heated atmosphere, under cover.

D. All gear and equipment delivered to the construction site after the building is under cover shall be protected as described above and in addition shall be provided with auxiliary heat to prevent condensation damage. The gear shall also be protected against damage caused by installation of any building systems and equipment; or damage caused by carelessness of workmen who are installing equipment connected to or adjacent to the above electrical equipment.

E. Equipment damaged as a result of the above conditions shall be properly repaired at the Contractor's expense or shall be replaced at the Contractor's expense, if, in the opinion of the Engineer the equipment has been damaged to such an extent it cannot operate properly after repairs are made.

F. All electrical enclosures exposed to construction damages such as paint spots, spackling or plaster spatter, grout splashes, waterproofing compound, tar spots or runs and pipe covering compound splashes, shall be completely covered and protected against damage.

G. In the event leakage into the building of any foreign material or fluid occurs or may occur, the Contractor shall take all steps as described above to protect any and all equipment.

H. After connections to electrical equipment are complete and the equipment is ready for operation, all construction debris shall be removed from all enclosures. Such debris includes dust, dirt, wire clippings, tape and insulation removed in order to make the connection.

3.4 ELECTRICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
   1. Coordinate electrical systems, equipment, materials, and installation with landscape/irrigation contractor(s).
   2. Verify all dimensions by field measurements.
   3. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
   4. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components where installed exposed in finished spaces.
   5. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. All equipment and disconnects shall maintain proper working space to conform to NEC.
   6. Install systems, materials, and equipment giving right-of-way priority to systems that require installation at a specified slope.
   7. Arrange for chases, slots and openings in other building components during progress of construction, to allow for electrical installation.
   8. Space, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work.

3.5 SUPERVISION AND COORDINATION:

A. Provide complete supervision, direction, scheduling and coordination of all work under the contract, including that of subcontractors, using full attention and the best skill. Be responsible for all work and make all subcontractors, suppliers and manufacturers fully aware of all requirements of the contract.

B. Coordinate the rough-in of all work performed under Divisions 22, 23 and 26.

C. The Contractor shall coordinate all electrical rough-ins with approved shop drawings and coordination drawings. Any rough-in installed without complete coordination shall be at the Contractor's risk and expense.

D. Coordinate the installation of all necessary rough-in of work, sleeves, anchors and supports for conduit, wiring, and other work performed under Divisions 23 and 26.

E. Coordinate the spacing and arrangement of lighting fixtures, diffusers, grilles and access panels in ceilings to establish a symmetrical pattern.

F. Where a discrepancy exists within the Specifications or drawings or between the Specifications and Drawings, the more stringent (or costly) requirement shall apply until a clarification can be obtained from the Engineer. Failure to clarify such discrepancies with the Engineer will not relieve the Contractor of the responsibility of conforming to the requirements of the Contract.

G. Failure of the Contractor to obtain a full and complete set of Contract Documents (either before or after bidding) will not relieve the Contractor of the responsibility of complying with the intent of the Contract Documents.

H. To insure proper electrical coordination between the electrical components supplied under Division 26 and the equipment supplied under Division 23, a schedule shall be submitted, prior to start of work, for review by the Engineer with the following column headings:

1.Equip	2. HP or	3. FLA	4.Voltage	5.	6. Capacitor	7.Moto	8.Disco	9.Control	10.Rema

. or Item	KVA		and Phase	Power Factor		r Starter	n.	s	rks

Description of Column Headings:

1. List all the approved equipment furnished under Division 23 that requires electrical connections and designate the equipment as it appears in Division 23. Indicate the quantity, if more than one, in parentheses of identical equipment being supplied.
2. Indicate the supplied horsepower of the equipment listed under Column No. 1. If equipment listed has more than one motor, indicate each motor and its respective horsepower. Indicate the kVA rating for all other equipment requiring an electrical connection, unless the electrical connection is for a control circuit only.
3. Indicate the full load amperes (FLA) for equipment listed under Column No. 1.
4. Indicate the voltage and phase requirements for equipment listed under Column No. 1. If more than one electrical circuit or voltage is required for the listed equipment, it shall be so indicated. Indicate wiring required for connection, including all phase, neutral, and ground conductors.
5. Indicate the power factor rating for all motors listed under Column No. 2.
6. Where a capacitor is to be provided, indicate specification division it is supplied under and indicate the KVAR size for any capacitor provided under Division 26.
7. Where a motor starter is required, indicate the specification division it is supplied under and the type of motor starter; across-the-line, reversible, variable speed, two speed-single winding, etc. Indicate In Column No. 9 if the motor starter provided under Division 26 is not compatible with the motor specified.
8. Where a disconnect switch is required by the National Electric Code or by the contract documents for the equipment listed under Column No. 1, indicate under which Division the disconnect switch is supplied.
9. Indicate the Division under which the controls for the equipment listed under Column No. 1 are provided.
10. Indicate any discrepancies between what is indicated in the contract documents and what is actually being provided.

I. The Contractor shall fully coordinate the electrical connections to all equipment prior to installations, with the approved Shop Drawings and the trades involved. Coordination shall include voltage, phases, quantity and size of wiring, device sizes, terminations, rough-in work, and other coordination for a complete installation.

J. Coordinate Division 26 work with all trades.

K. Install work with proper clearances and access. Carefully examine all contract drawings and fit the work in each location without substantial alteration. Where departures are proposed or required, submit detailed drawings for acceptance. The right is reserved to make reasonable changes in location of equipment, conduit and wiring up to the time of rough-in or fabrication.

L. Coordinate electrical work with architectural items and equipment.

M. This Contractor shall make all system connections required to equipment furnished and installed under other divisions. Connections shall be complete in all respects to render this equipment functional to its fullest intent. The Contractor shall make all system connections required to equipment furnished under other Divisions. Circuits shall be extended to all equipment which is incidental to, but not necessarily shown, for equipment specified under other divisions such as magnetic flow meters, ATC panels, liquid level controls, leak detection systems, etc. Connections shall be complete in all respects to render this equipment functional to its fullest extent.

N. It shall be the responsibility of the Contractor to obtain complete instructions for connections.

3.6 GUARANTEE:

A. Guarantee obligations shall be as hereinbefore specified in the GENERAL AND SPECIAL CONDITIONS of these specifications, except as follows:
   1. Guarantee the complete electrical system free from all mechanical and electrical defects for the period of two (2) years beginning from the day of final acceptance of the work by the Owner.

2. Also, during the guarantee period, be responsible for the proper adjustments of all systems, equipment and apparatus installed by the Contractor and do all work necessary to ensure efficient and proper functioning of the systems and equipment.
3. Upon receipt of notice from the Owner of failure of any part of the electrical installation during the guarantee period, new replacement parts shall be furnished and installed promptly at no cost.
4. Warranty From the Manufacturer: Contractor shall obtain all warranty papers and records from the Original Equipment Manufacturer according to their warranty policy and deliver the same to the Owner. Contractor shall fulfill all the Original Manufacturer's requirements to validate the warranty as offered by the Original Equipment Manufacturer.

B. Provide 24-hour service for any and all warranty problems experience in the operation of the equipment provided.

C. Any equipment or system in need of warranty work whether during regular hours or on an emergency basis, shall be immediately serviced and repaired. The warranty work and guarantee shall include all parts and labor and shall be furnished at no cost to the Owner.

D. The Contractor shall guarantee to make good any and all defects in his work, exclusive of lamps, which may develop due to defective workmanship or materials, within one year from the date of final acceptance of the work by the Owner.

E. In addition to the warranty and correction of work obligations contained in the General and supplementary Conditions, correct the work of the system as embraced by the Specification, free from Mechanical and Electrical defects for the warranty period beginning from the day of acceptance of the building by the Architect for the beneficial use of the Owner.

F. During the warranty period, take responsibility for the proper adjustments of systems, equipment and apparatus installed and perform work necessary to ensure the efficient and proper functioning of the systems and equipment.

G. Certain items of equipment hereinafter specified shall be guaranteed for a longer time than the general warranty period. These guarantees shall be strictly adhered to and the Contractor shall be responsible for service or replacement required in connection with guarantee of these items. These guarantees shall commence on the same date as the final acceptance by the Architect.

H. Submission of a bid proposal for this Project warrants that the Contractor has reviewed the Contract Documents and has found them free from ambiguities and sufficient for the construction and proper operation of systems installed for this project. If discrepancies are found, have them clarified by Addendum.

I. It is possible that certain areas of the building or certain systems will be accepted at a time different than as specified. The date of acceptance by the Architect for beneficial use of the Owner for these building areas or systems will be adjusted accordingly.

3.7 SCHEDULING OF WORK:

A. The Contractor shall not be permitted to do any work in any area of any occupied building during normal hours, except in areas specifically assigned.

B. Coordination of work by the Contractor is essential such that power outages are kept to a minimum in quantity and duration. All required outages shall be approved by the Owner for optimum time scheduling. Written notice of not less than 15 calendar days shall precede all power outages.

3.8 TEMPORARY POWER:

A. Obtain and pay for temporary electrical service for construction power. Provide electric panels and GFI receptacles as required.

B. Provide adequate temporary lighting for construction purposes until permanent lighting is available.

3.9 PAINTING AND FINISHES:

A. Provide protective finishes on all materials and equipment. Use coated or corrosion-resistant materials, hardware and fittings throughout the work. Paint bare, untreated ferrous surfaces with rust-inhibiting paint. All exterior components including supports, hangers, nuts, bolts, washers, vibration isolators, etc., shall be galvanized or stainless steel.

B. Clean surfaces prior to application of coatings, paint, or other finishes.

C. Provide factory-applied finishes where specified. Unless otherwise indicated factory-applied paints shall be baked enamel with proper pre-treatment.

D. Protect all finishes and restore any finishes damaged as a result of work under Division 26 to their original condition.

E. The preceding requirements apply to all work, whether exposed or concealed.

F. Remove all construction marking and writing from exposed equipment, conduit, and building surfaces. Do not paint manufacturer's labels or tags.

G. All exposed conduit, etc., shall be painted, except in electrical rooms, mechanical rooms, storage rooms, and crawl spaces. Colors shall be selected by the Architect and conform to ANSI Standards.

H. Submit color of factory-finished equipment for approval prior to ordering.

3.10 PROTECTION OF WORK:

A. Protect work, material and equipment from weather and construction operations before and after installation. Properly store and handle all materials and equipment.

B. Cover temporary openings in conduit and equipment to prevent the entrance of water, dirt, debris, or other foreign matter.

C. Cover or otherwise protect all finishes.

D. Replace damaged materials, devices, finishes and equipment.

3.11 OPERATION OF EQUIPMENT:

A. Clean all systems and equipment prior to initial operation for testing, retesting, or other purposes. Set, adjust, and test all equipment in accordance with manufacturer's instructions. Do not operate equipment unless all proper safety devices or controls are operational. Provide all maintenance and service for equipment that is authorized for operation during construction.

B. Where specified, or otherwise required, provide the services of the manufacturer's factory-trained servicemen or technicians to start up the equipment.

C. Do not use electrical systems for temporary services during construction unless authorized in writing by the Owner. Where such authorization is granted, temporary use of equipment shall in no way limit or otherwise affect warranties or guaranty period of the work.

D. Upon completion of work, clean and restore all equipment to new conditions; replace expendable items such as filters.

3.12 TESTING AND ADJUSTMENT

A. Perform all tests which are specified or required to demonstrate that the work is installed and operating properly. Where formal tests are required, give proper notices and perform all necessary preliminary tests to assure that the work is complete and ready for final test.

B. Adjust all systems, equipment and controls to operate in a safe, efficient and stable manner.

C. On all circuits, 600 volts or less, provide circuits that are free from ground faults, short circuits and open circuits.

D. Other tests of a specific nature for special equipment shall be as specified under the respective equipment.

3.13 IDENTIFICATIONS, ELECTRICAL DIAGRAMS AND OPERATING INSTRUCTIONS:

A. Contractor shall submit for approval schematic diagrams of each electrical system installed in the building. Diagrams shall indicate device location, service, type, make, model number and the identification number of each device in the particular system. Following approval by all authorities, the diagrams shall be framed, mounted under glass and hung in each Main Equipment Room where directed. Contractor shall deliver the tracing or sepia from which the diagrams were reproduced to the Owner.

B. All equipment shall be plainly tagged.

C. All items of equipment, including motor starters, panels, etc., shall be furnished with white letters and numbers on black plastic identification plates or aluminum letters and numbers on black engraved aluminum identification plates. Lettering shall be a minimum of 1/4" high. Identification plates shall be securely affixed to each piece of equipment, starters, panels, etc., by screws or adhesive (Tuff-Bond #TB2 or as approved equal). Pressure sensitive tape backing is prohibited.

D. Provide three (3) copies of operating and maintenance instructions for all principal items of equipment furnished. This material shall be bound as a volume of the "Record and Information Booklet" as hereinafter specified.

E. Provide at least 24 hours of straight time instruction to the operating personnel. This instruction period shall consist of not less than three (3) consecutive 8-hour days. Time of instruction shall be designated by the Owner. Provide two DVD video disks of all instructional periods/demonstrations.

3.14 RECORD DRAWINGS AND SPECIFICATIONS:

A. Upon completion of the Electrical installations, the Contractor shall deliver to the Engineer one complete set of prints of the Electrical Contract Drawings which shall be legibly marked in red pencil to show all Addenda, approved Shop Drawings, Change Orders, changes and departures of the installation as compared with the original design. They shall be suitable for use in preparation of Record Drawings.

B. The Contractor shall provide a record specification including all Addenda and other modifications. Record substantial variations in actual work performed. Identify all substitutions.

3.15 RECORD AND INFORMATION BOOKLET:

A. The Contractor shall have prepared three (3) copies of the Record and Information Booklet and deliver these copies of the booklet to the Owner. The booklet shall be as specified herein. The booklet must be approved and will not be accepted as final until so stamped.

B. The booklet shall be bound in a three-ring loose-leaf binder similar to "National" No. 3881 with the following title lettered on the front and on the spine of the binder: "Record and Information Booklet (insert name of the project)". No sheets larger than 8-1/2" x 11" shall be used, except sheets that may be neatly folded to 8-1/2" x 11" and used as a pull-out. An Index will include the section tabs for each subject included. If more than one binder is required, print covers and spines with Volume numbers. Include in the front of every binder an index to all binders.
   1. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
   2. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, typed on white paper.
   3. Part 1: Directory, listing names, addresses, and telephone numbers of Electrical Engineers; Contractor; Electrical Subcontractors; and major Electrical equipment suppliers. Provide sales and service representative names and phone numbers of all equipment.
   4. Part 2: Operation and Maintenance Instructions, arranged by Specification Section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
      a. Significant design criteria.
      b. List of equipment. Complete record of material list. Catalog brochures and product data for all components. Include all submittal comments, and corrected catalog data and shop drawings on each piece of equipment and each system.

c. Parts list for each component, including recommended spare parts list. Include motor starter overload schedules.

d. Operating instructions, including sequence of operation.

1) Description of function, normal operating characteristics and limitations, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts. Provide a description of each system installed.

2) Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; control, stopping.

e. Maintenance instructions for equipment and systems. Detailed checkout procedures to insure operation of systems and gear, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

f. Servicing, diagnostic and troubleshooting instructions and procedures for systems and major equipment.

g. Recommended preventative maintenance program, including a list of items requiring inspection and servicing. Provide Chart Form indicating time and type of routine and preventative maintenance of electrical equipment, etc. The chart shall also indicate tag number, model number of equipment, location and service.

1) For replacement items, indicate type, size and quantity of the replaceable items.

2) Provide lubrication schedule, including type, grade, temperature range and frequency.

3) Provide a list of each type of lighting fixture lamp used, lamp fixture used, and source.

4) Include estimated mean time between failures for major parts.

h. Wiring Diagrams, Block Diagrams, and Assembly Drawings.

i. Panelboard Circuit Directory for each panelboard, including Panel Name, Panel Location, Panel Ratings, spare circuit breakers, spaces for additional circuit breakers.

j. List of equipment keys turned over to the Owner.

5. Part 3: Project Documents and Certificates, including the following:

a. Shop Drawings and Product Data. Record Documents of the systems.

b. Photocopies of certificates.

c. Photocopies of Manufacturers' and Contractors' warranties, guarantees.

d. Test Reports: Copies of the approved results of all tests required under all sections of specifications.

e. Inspection Certificates.

f. Manufacturer's Conformance Certificates.

6. Provide one copy (DVD video disk) of video instruction session with each booklet set. Label video disk with all pertinent information.

7. Submit one copy of completed volumes in final form 15 days prior to final Inspection. This copy will be returned with Engineer comments. Revise content of documents as required prior to final submittal.

8. Submit final volumes revised, within ten days after final inspection.

C. Upon completion of the project, the Contractor shall furnish the Owner a complete list of suppliers of equipment for parts and maintenance purposes. The list shall include the name, address, and telephone number of the parts and maintenance firm on a single 8-1/2" x 11" sheet of paper.

D. This item shall include the furnishing of a complete list of equipment installed on the project, including the Manufacturer's name, the make and model number of the equipment, and address and telephone number of the nearest supplier who stocks maintenance and/or replacement parts. The list should be submitted along with as-built drawings and be typed in an organized manner.

3.16 INSTALLATION AND COORDINATION DRAWINGS:

A. In congested areas, prepare, submit, and use composite installation and coordination drawings to assure proper coordination and installation of work. Drawings shall include, but not be limited, to the following: Complete Electrical Drawings showing coordination with lights, electrical equipment, mechanical, plumbing, HVAC, structural, and architectural elements and provision for access.

B. Draw plans to a scale not less than 3/8-inch equals one foot. Include plans, sections, and elevations of proposed work, showing all equipment and conduit in areas involved. Fully dimension all work including lighting fixtures, conduits, pullboxes, panelboards, and other electrical work, walls, doors, ceilings, columns, beams, joists, mechanical equipment, and other architectural and structural work.

C. Identify all equipment and devices on wiring diagrams and schematics. Where field connections are shown to factory-wired terminals, include manufacturer's literature showing internal wiring.

END OF SECTION 26 05 01

SECTION 26 05 10 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Advance Products & Systems, Inc.
b. Metraflex Co.
c. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants".

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Firestopping."

END OF SECTION 26 05 10

SECTION 26 05 19- LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency.

C. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a Nationally Recognized Testing Laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN, XHHW, USE and SO.

D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC and Type SO with ground wire.

E. Conductors shall be rated 75 deg C in wet locations and 90 deg C in dry locations.

2.2 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers:

1. Alpha Wire Company.
2. American Bare Conductor
3. Belden, Inc.
4. Cerro Wire LLC
5. General Cable Technologies
6. Service Wire Co.
7. Southwire Company
8. WESCO

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. RoHS compliant.
4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. Single circuit.

E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

F. Ground Conductor: Insulated.

G. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.

H. Armor: Aluminum interlocked.

2.3 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Hubbell Power Systems, Inc.
2. O-Z/Gedney; EGS Electrical Group LLC.
3. 3M; Electrical Products Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders and Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. 600 volt, unless otherwise noted, #12 AWG minimum (except control cable may be #14 AWG).

B. Service Entrance: Type THHN-THWN, single conductors in raceway.

C. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

D. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

E. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

F. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway, except Metal-clad cable, Type MC, may be used for branch circuits above accessible ceilings, drywall partitions and at a maximum of 20 feet in length.

H. Type MC Cable may be used in short lengths (6 foot maximum) for final connections to lighting fixtures. MC Cable shall not be used between fixtures.

I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, and strain relief device at terminations to suit application.

K. Class 1 Control Circuits: Type THHN-THWN, in raceway.

L. Class 2 Control Circuits: Type THHN-THWN, in raceway.

M. Conductors shall be rated 75 deg C in wet locations and 90 deg C in dry locations.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips,that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Section 16071, "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Section 16075, "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 8 inches (200 mm) of slack.

D. Wiring for general 15 and 20 amp 120 volt and 277 volt branch circuit work shall be as follows unless otherwise indicated:

HOME RUN LENGTH AND WIRE SIZE				**CIRCUIT LENGTH AND WIRE SIZE**			
120 Volt		277 Volt		120 Volt		277 Volt	
0 – 60’	#12	0 – 175’	#12	0 – 100’	#12	0 – 200’	#12
60 – 100’	#10	175 – 350’	#10	100’ & Up	#10	200’ & Up	#10
100’ & Up	#8	350’ & Up	#8				

Circuit length as given above shall be the wire length between the first and last outlet on the circuit. Home run length as given above shall be the wire length between the first outlet and the panelboard. In accordance with the above, where the size of branch circuit conductors is increased by the minimum required by the NEC for the branch circuit rating, it is the Contractor’s responsibility to insure that the termination provisions of all equipment connected to such circuits are listed as suitable for the conductor sizes involved.

E. Joints of #10 AWG and smaller shall be made with properly insulated solderless type pressure connectors. Where stranded conductors or multiple solid conductors are connected to terminals, solderless lugs manufactured by Thomas and Betts Company or equivalent shall be used.

F. Joints of #8 AWG and larger in power and lighting circuits shall be of the type indented into the conductor by means of a hand or hydraulic pressure tool. Connectors shall be Burndy “Hy-dent’, T&B “St-Kon”, or equivalent. Connectors for control wiring shall be Burndy “Hy-Lug”, or equivalent.

G. All circuits for exterior electric work shall be #10 AWG (minimum) and contain an extra #10 AWG (minimum) copper ground conductor. All exterior wiring shall be installed in conduit as specified above, unless otherwise noted as larger on the Drawings.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 26 Section "Firestopping." and “Basic Electrical Materials and Methods”.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal underground exterior-wall penetrations according to Division 26 Section, “Basic Electrical Materials and Methods”.

3.7 FIRESTOPPING

Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 7 Section "Through Penetration Firestop System."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing agency to perform field quality-control testing.

B. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements. Procedures: Perform each visual and mechanical inspection and electrical test state din NETA ATS Section 7.3.1. Certify compliance with test parameters.

C. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

D. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

E. Verify continuity of each branch circuit conductor.

F. Tests: Service Entrance Cables, Power & Lighting Distribution Feeders and Feeders to all major mechanical equipment at 60A and over (i.e., chillers, AHU's, etc.).
   1. Tests shall be performed with a 1000-volt megger, and conductors shall test free from short-circuits and grounds.
   2. Conductors shall be tested phase-to-phase and phase-to-ground.
   3. Furnish the instruments, materials, and labor required. Perform the tests in the presence of the Contracting Officer.
   4. Test readings shall be recorded and delivered to Owner and Engineer in a report.
   5. Copy of Test results shall be included in O&M Manuals.

G. Demonstration: Subsequent to wire and cable hook-ups, energize circuit and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

1. This Section includes methods and materials for grounding systems and equipment.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:

1. Grounding arrangements and connections for separately derived systems.

C. Qualification Data: For testing agency and testing agency's field supervisor.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:

1. Instructions for periodic testing and inspection of grounding features at ground rings, grounding connections for separately derived systems, based on NFPA 70B.

a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel**,** sectional type; 3/4 inch by10 feet (19 mm by 3 m) in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger, unless otherwise indicated.

B. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits of the same type as the circuit conductors. Install in same conduit with circuit conductors.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

C. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

D. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

B. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal**,** and at individual ground rods. Make tests at ground rods before any conductors are connected.

a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
b. Perform tests by fall-of-potential method according to IEEE 81.

3. Prepare dimensioned drawings locating each ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment: 10 ohms.

D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 and Division 15.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Thomas & Betts Corporation (Kindorf).
      b. Unistrut; Tyco International, Ltd.
      c. Wesanco, Inc. (Westrut).

   2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   4. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

      a. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

         1) Hilti Inc.
         2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
         3) MKT Fastening, LLC.

   2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

      a. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         1) Hilti Inc.
         2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

3) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

C. Submit structural calculations for load and strength of each component and detailing of each assembly.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. FMC: Flexible metal conduit.

D. IMC: Intermediate metal conduit.

E. LFMC: Liquid tight flexible metal conduit.

F. LFNC: Liquid tight flexible nonmetallic conduit.

G. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.

C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members in the paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Allied Tube & Conduit; a Tyco International Ltd. Co.
2. Electri-Flex Co.
3. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit or IMC.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

E. EMT: ANSI C80.3.

F. FMC: Zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket.

H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT: Compression type.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Anamet Electrical, Inc.; Anaconda Metal Hose.
2. Electri-Flex Co.
3. Lamson & Sessions; Carlon Electrical Products.

B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

C. LFNC: UL 1660.

D. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

E. Fittings for LFNC: UL 514B.

2.3 METAL WIREWAYS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type.

E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Owner.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Thomas & Betts Corporation.
b. Walker Systems, Inc.; Wiremold Company (The).
c. Wiremold Company (The); Electrical Sales Division.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. Hoffman.
3. Walker Systems, Inc.; Wiremold Company (The).
4. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

H. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit.
2. Concealed Conduit, Aboveground: Rigid steel conduit.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried unless otherwise indicated.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
6. Underground Conduit for Exterior Lighting: Continuous PVC, type HDPE.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Severe Physical Damage: Rigid steel conduit for sizes 2-1/2-inches and larger, EMT for sizes smaller than 2-1/2 inches.
2. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:

    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.
    d. Electrical rooms.

3. Concealed in Ceilings and Interior Walls and Partitions: Rigid steel conduit for sizes 2-1/2-inches and larger, EMT for sizes smaller than 2-1/2 inches.
4. Exposed in finished space ceilings: EMT painted to match surrounding finish.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): Use LFMC.
6. Damp or Wet Locations: Rigid steel conduit.
7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical fiber/communications cable raceway: EMT
8. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: Riser-type, optical fiber/communications cable raceway: EMT
9. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT.
10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Section 16071, "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

I. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from RNC, Type EPC-40-PVC to GRC before rising above floor.

J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

M. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m).

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:

a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.

c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
d. Attics: 135 deg F (75 deg C) temperature change.

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change.
3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

N. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

O. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

3.3 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Firestopping."

3.4 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 05 43- UNDERGROUND DUCTBANKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
2. Handholes and boxes.
3. Manholes.

1.3 DEFINITION

A. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Duct-bank materials, including separators and miscellaneous components.
2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Accessories for manholes, handholes, boxes**,** and other utility structures.
4. Warning tape.
5. Warning planks.

B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Reinforcement details.
3. Frame and cover design and manhole frame support rings.
4. Ladder details.
5. Grounding details.
6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
7. Joint details.

C. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Cover design.
3. Grounding details.
4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

D. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.

1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
2. Drawings shall be signed and sealed by a qualified professional engineer.

E. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.

F. Qualification Data: For professional engineer and testing agency.

G. Source quality-control test reports.

H. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Comply with ANSI C2.

C. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.7 COORDINATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Furnish cable-support stanchions, arms, insulators, and associated fasteners in quantities equal to 5 percent of quantity of each item installed.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ARNCO Corp.
2. Beck Manufacturing.
3. Cantex, Inc.
4. CertainTeed Corp.; Pipe & Plastics Group.
5. Condux International, Inc.
6. ElecSys, Inc.
7. Electri-Flex Company.
8. IPEX Inc.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT; a division of Cable Design Technologies.
11. Spiraduct/AFC Cable Systems, Inc.

B. Underground Plastic Utilities Duct: NEMA TC 6 & 8, Type EB-20-PVC, ASTM F 512, UL 651A, with matching fittings by the same manufacturer as the duct, complying with NEMA TC 9.

C. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Division 26 Section.
3. Concrete Warning Planks: Nominal 12 by 24 by 3 inches (300 by 600 by 76 mm) in size, manufactured from 6000-psi (41-MPa) concrete.

    a. Color.
    b. Mark each plank with "ELECTRIC" in 2-inch- (50-mm-) high, 3/8-inch- (10-mm-) deep letters.

2.3 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Description: Comply with SCTE 77.

1. Color: Gray.
2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC," "TELEPHONE," or as indicated for each service.
6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.

7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long**)** and larger shall have factory-installed inserts for cable racks and pulling-in irons.

B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. Armorcast Products Company.
b. Carson Industries LLC.
c. CDR Systems Corporation.
d. NewBasis.

C. Fiberglass Handholes and Boxes with Polymer Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. Armorcast Products Company.
b. Carson Industries LLC.
c. Christy Concrete Products.
d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.

2.4 PRECAST MANHOLES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Christy Concrete Products.
2. Elmhurst-Chicago Stone Co.
3. Oldcastle Precast Group.
4. Rinker Group, Ltd.
5. Riverton Concrete Products.
6. Utility Concrete Products, LLC.
7. Utility Vault Co.
8. Wausau Tile Inc.

B. Comply with ASTM C 858.

C. Structural Design Loading: Comply with requirements in "Underground Enclosure Application" Article.

D. Precast Manholes: One-piece units and units with interlocking mating sections, complete with accessories, hardware, and features.

E. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks, plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.

1. Windows shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
2. Window opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
3. Window openings shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.

F. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

1. Type and size shall match fittings to duct or conduit to be terminated.
2. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.

G. Concrete Knockout Panels: 1-1/2 to 2 inches (38 to 50 mm) thick, for future conduit entrance and sleeve for ground rod.

H. Ground Rod Sleeve: Provide a 3-inch (75-mm) PVC conduit sleeve in manhole floors 2 inches (50 mm) from the wall adjacent to, but not underneath, the ducts routed from the facility.

I. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.5 UTILITY STRUCTURE ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Bilco Company (The).
2. Campbell Foundry Company.
3. Christy Concrete Products.
4. East Jordan Iron Works, Inc.
5. Elmhurst-Chicago Stone Co.
6. McKinley Iron Works, Inc.
7. Neenah Foundry Company.
8. NewBasis.
9. Oldcastle Precast Group.
10. Osburn Associates, Inc.
11. Pennsylvania Insert Corporation.
12. Quazite:Hubbell Power Systems, Inc.
13. Rinker Group, Ltd.
14. Riverton Concrete Products.
15. Underground Devices, Inc.
16. Utility Concrete Products, LLC.
17. Utility Vault Co.
18. Wausau Tile Inc.

B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.

1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 29 inches (725 mm).

    a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
    b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.

2. Cover Legend: Cast in. Selected to suit system.

    a. Legend: "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
    b. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.

3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
    a. Seal joints watertight using preformed plastic or rubber conforming to ASTM C 990. Install sealing material according to the sealant manufacturers' printed instructions.

C. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch- (50-mm-) diameter eye, and 1-by-4-inch (25-by-100-mm) bolt.

1. Working Load Embedded in 6-Inch (150-mm), 4000-psi (27.6-MPa) Concrete: 13,000-lbf (58-kN) minimum tension.

D. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- (22-mm-) diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.

1. Ultimate Yield Strength: 40,000-lbf (180-kN) shear and 60,000-lbf (270-kN) tension.

E. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch (13-mm) ID by 2-3/4 inches (69 mm) deep, flared to 1-1/4 inches (31 mm) minimum at base.

1. Tested Ultimate Pullout Strength: 12,000 lbf (53 kN) minimum.

F. Ground Rod Sleeve: 3-inch (75-mm), PVC conduit sleeve in manhole floors 2 inches (50 mm) from the wall adjacent to, but not underneath, the ducts routed from the facility.

G. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch (13-mm) bolt, 5300-lbf (24-kN) rated pullout strength, and minimum 6800-lbf (30-kN) rated shear strength.

H. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.

1. Stanchions: Nominal 36 inches (900 mm) high by 4 inches (100 mm) wide, with minimum of nine holes for arm attachment.
2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3 inches (75 mm) with 450-lb (204-kg) minimum capacity to 20 inches (500 mm) with 250-lb (114-kg) minimum capacity. Top of arm shall be nominally 4 inches (100 mm) wide, and arm shall have slots along full length for cable ties.

I. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C). Capable of withstanding temperature of 300 deg F (150 deg C) without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

J. Portable Manhole Ladders: UL-listed, heavy-duty fiberglass specifically designed for portable use for access to electrical manholes. Minimum length equal to distance from deepest manhole floor to grade plus 36 inches (900 mm). One required.

K. Cover Hooks: Heavy duty, designed for lifts 60 lbf (270 N) and greater. Two required.

2.6 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by a independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.

3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

C. Clear and grub vegetation to be removed, and protect vegetation to remain according to Division 02 Section "Clearing." Remove and stockpile topsoil for reapplication according to Division 02 Section "Clearing."

3.2 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Feeders 600 V and Less: RNC**,** NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

B. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

C. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

D. Underground Ducts for Telephone, Communications, or Data Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

E. Underground Ducts Crossing Paved Paths, walks, driveways and roadways: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

F. Ducts for electrical feeders over 600V: RNC, NEMA Type EPC-40-PVC, direct-buried, unless otherwise noted.

3.3 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less:

1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 8 structural load rating.
4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.
5. Cover design load shall not exceed the design load of the handhole or box.

B. Manholes: Precast concrete.

1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.4 EARTHWORK

A. Excavation and Backfill: Comply with Division Section "Earthwork" but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division Sections "Lawns and Grasses" and "Exterior Plants."

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."

3.5 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 25 feet (7.5 m), both horizontally and vertically, at other locations, unless otherwise indicated.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
3. Grout end bells into structure walls from both sides to provide watertight entrances.

E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet (3 m) outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Basic Electrical Materials and Methods."

F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.

G. Pulling Cord: Install 100-lbf- (445-N-) test nylon cord in ducts, including spares.

H. Concrete-Encased Ducts: Support ducts on duct separators.

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

    a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
    b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (19-mm) reinforcing rod dowels extending 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.

3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
6. Minimum Space between Ducts: 3 inches (75 mm) between ducts and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and signal ducts.
7. Depth: Install top of duct bank at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.
8. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.

9. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

I. Direct-Buried Duct Banks:

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches (150 mm) between tiers.
3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division Section "Earth Moving" for pipes less than 6 inches (150 mm) in nominal diameter.
4. Install backfill as specified in Division Section "Earth Moving."

5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Division Section "Earth Moving."
6. Install ducts with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and signal ducts.
7. Depth: Install top of duct bank at least 36 inches (900 mm) below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
10. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

11. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above direct-buried ducts and duct banks, placing them 24 inches (600 mm) o.c. Align tape parallel to and within 3 inches (75 mm) of centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional planks 12 inches (300 mm) apart, horizontally.

3.6 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891 unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:

1. Manhole Roof: Install with rooftop at least 15 inches (375 mm) below finished grade.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch (25 mm) above finished grade.
3. Install handholes with bottom below frost line.
4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
5. Where indicated, cast handhole cover frame integrally with handhole structure.

C. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

D. Manhole Access: Circular opening in manhole roof; sized to match cover size.

1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.

2. Install chimney, constructed of precast concrete collars and rings, to support cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for frame to chimney.

E. Waterproofing: Apply waterproofing to exterior surfaces of manholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Division 07. After ducts have been connected and grouted, and before backfilling, waterproof joints and connections, and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.

F. Dampproofing: Apply dampproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Dampproofing materials and installation are specified in Division 07. After ducts are connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.

G. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms as required for installation and support of cables and conductors and as indicated.

H. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches (97 mm) for manholes and 2 inches (50 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.7-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.

D. Install handholes and boxes with bottom below the frost line, below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.

1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Division 03 Section "Cast-in-Place Concrete," with a troweled finish.
2. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep).

3.8 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section "Grounding."

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.10 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 26 05 43

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Identification for raceway and metal-clad cable.
2. Identification for conductors and communication and control cable.
3. Warning labels and signs.
4. Instruction signs.
5. Equipment identification labels.
6. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and ANSI C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.145.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Color for Printed Legend:

1. Power Circuits: Black letters on an orange field.
2. Legend: Indicate system or service and voltage.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

C. Aluminum Wraparound Marker Labels: Cut from 0.014-inch- (0.35-mm-) thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.

D. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking nylon tie fastener.

E. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.3 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 10 by 14 inches (250 by 360 mm).

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.4 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.5 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

2.6 CABLE TIES

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength: 50 lb (22.6 kg), minimum.
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Paint materials and application requirements are specified in Division 09 painting Sections.

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A: Identify with orange self-adhesive vinyl tape applied in bands.

B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:

1. Fire Alarm System: Red.
2. Security System: Blue and yellow.
3. Telecommunication System: Green and yellow.
4. Control Wiring: Green and red.

C. Power-Circuit Conductor Identification: For primary and secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

D. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use aluminum wraparound marker labels. Identify each ungrounded conductor according to source and circuit number.

E. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.

F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:

a. Power transfer switches.
b. Controls with external control power connections.
c. Specialty power and/or lighting control cabinets.

2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

H. Instruction Signs:

1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.

I. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where 2 lines of text are required, use labels 2 inches (50 mm) high.
b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
d. Fasten labels with appropriate mechanical fasteners that do not invalidate the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards, electrical cabinets, and enclosures.
b. Access doors and panels for concealed electrical items.
c. Electrical switchgear and switchboards.
d. Transformers.
e. Emergency system boxes and enclosures.
f. Motor-control centers.
g. Disconnect switches.
h. Enclosed circuit breakers.
i. Motor starters, including variable-speed controllers.
j. Push-button stations.
k. Contactors.
l. Remote-controlled switches, dimmer modules, and control devices.
m. Battery inverter units.
n. Battery racks.
o. Fire-alarm control panel and annunciators.

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
2. Colors for 208/120-V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.
d. Neutral: White.
e. Ground: Green.

3. Colors for 480/277-V Circuits:

    a. Phase A: Brown.
    b. Phase B: Orange.
    c. Phase C: Yellow.
    d. Neutral: White with colored stripe or gray.
    e. Ground: Green.

4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

I. Painted Identification: Prepare surface and apply paint according to Division 09 painting Sections.

END OF SECTION 26 05 53

SECTION 26 05 73 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study. Provide Arc-Flash Hazard Labels on all electrical distribution equipment with level as determined by Study. **Electrical equipment shop drawings will not be reviewed/approved until the overcurrent protective device coordination study has been submitted.**

1.3 SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

C. Qualification Data: For coordination-study specialist.

D. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals may be in digital form.

1. Coordination-study input data, including completed computer program input data sheets.
2. Study and Equipment Evaluation Reports.
3. Coordination-Study Report.
4. Arc Fault Hazards Evaluation.

1.4 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Engineering Analysis and Coordination Study performed by Coordinated Power Engineering, Inc., or a comparable product by one of the following:

1. CGI CYME.
2. EDSA Micro Corporation.
3. ESA Inc.
4. Operation Technology, Inc.
5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

a. Arcing faults.
b. Simultaneous faults.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

3.2 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:

a. Circuit-breaker and fuse-current ratings and types.
b. Relays and associated power and current transformer ratings and ratios.

c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
d. Generator kilovolt amperes, size, voltage, and source impedance.
e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
f. Busway ampacity and impedance.
g. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

a. Special load considerations, including starting inrush currents and frequent starting and stopping.
b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
d. Generator thermal-damage curve.
e. Ratings, types, and settings of utility company's overcurrent protective devices.
f. Special overcurrent protective device settings or types stipulated by utility company.
g. Time-current-characteristic curves of devices indicated to be coordinated.
h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:

1. Switchboard bus.
2. Motor-control center.
3. Distribution panelboard.
4. Branch circuit panelboard.
5. Automatic Transfer Switch.

B. Study electrical distribution system from normal power sources throughout electrical distribution system for Project.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141, and IEEE 242.

1. Transformers:
   a. IEEE C57.12.00.
   b. IEEE C57.96.
2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
3. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.

F. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum ground-fault currents.

B. Comply with IEEE 141 and IEEE 242 recommendations for fault currents and time intervals.

C. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

a. Inrush current when first energized.
b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

E. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:

a. Device tag.
b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
d. Fuse-current rating and type.
e. Ground-fault relay-pickup and time-delay settings.

2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

a. Device tag.
b. Voltage and current ratio for curves.
c. Three-phase and single-phase damage points for each transformer.

d. No damage, melting, and clearing curves for fuses.
e. Cable damage curves.
f. Transformer inrush points.
g. Maximum fault-current cutoff point.

F. Completed data sheets for setting of overcurrent protective devices.

3.5 ARC-FLASH HAZARD

A. Perform Arc-Flash Hazard Analysis and provide results indicating personnel protective equipment required for the potential hazard.

END OF SECTION 26 05 73

SECTION 26 05 74- OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form.

1. Arc-flash study input data, including completed computer program input data sheets.
2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.

   a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Arc-Flash Study Specialist.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.
2. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.6 QUALITY ASSURANCE

Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

A. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

B. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

C. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CGI CYME.
2. EDSA Micro Corporation.
3. ESA Inc.
4. Operation Technology, Inc.
5. Power Analytics, Corporation.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate mandatory features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

F. Arc-Flash Study Output:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.

c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

G. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Working distance.
6. Incident energy.
7. Hazard risk category.
8. Recommendations for arc-flash energy reduction.

H. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies:
1. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

C. Calculate maximum and minimum contributions of fault-current size.

1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the

changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors shall be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond three to five cycles.

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.

1. Verify completeness of data supplied on the one-line diagram on Drawings Call discrepancies to the attention of Architect.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Electrical Survey Data: Gather and tabulate the following input data to support study.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
5. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
6. Motor horsepower and NEMA MG 1 code letter designation.
7. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.4 DEMONSTRATION

A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION 26 05 74

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Photoelectric switches.
2. Standalone daylight-harvesting switching and dimming controls.
3. Indoor occupancy and vacancy sensors.
4. Switchbox-mounted vacancy sensors
5. Lighting contactors.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show installation details for the following:

a. Occupancy sensors.
b. Vacancy sensors.

2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.
4. Floor plans with all sensor locations and associated coverage patterns. Sensor layouts displayed on drawings are product specific to basis of design.

1.4 ALTERNATE MANUFACTURERS:

A. Refer to specification section 26 51 19 – 1.3.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Field quality-control reports.

C. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Software and firmware operational documentation.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: Two (2) years from date of Substantial Completion.

1.8 ADDITIONAL MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Occupancy Sensors – Ceiling Mounted Low Voltage: Provide 1 additional Sensor with associated power pack for every 25 sensors with same rating and coverage area. Furnish at least 5 units.
2. Occupancy Sensors – Wall Mounted Low Voltage: Provide 1 additional Sensor with associated power pack for every 25 sensors with same rating and coverage area. Furnish at least 5 units.
3. Vacancy Sensors – Ceiling Mounted Low Voltage deriving power/connected to associated Room Controller: Provide 1 additional sensor for every 25 sensors of each type, rating and coverage area. Furnish at least 5 units.
4. Vacancy Sensor Switch combination: Provide 1 additional Sensor Switch Combination for every 25 of each type, rating and coverage area. Furnish at least one of each type.
5. Vacancy Sensor Dimmer Switch combination: Provide 1 additional Sensor Dimmer Switch combination for every 25 of each type, rating and coverage area. Furnish at least one of each type.

B. Provide each group listed above in separate packaging/boxes with labeling indicating typical function.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY AND VACANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Eaton Controls/ILC.
2. Wattstopper/Legrand.
3. Steinel/Crestron.

B. General Requirements for Sensors:

1. Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
2. Passive infrared Ultrasonic Dual technology.
3. Separate power pack.
4. Hardwired connection to switch in stand-alone rooms.
5. Low voltage connections via networked lighting control panels.
6. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
7. Operation:
   a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
   b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
   c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
8. Sensor Output: Sensor is powered from the power pack.
9. Power Pack: Dry contacts rated for 20-A ballast LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
10. Power Failure memory:
    a. Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and parameters saved in protected memory shall not be lost.
    b. Designed and tested to withstand discharges without impairment of performance when subjected to dischargers of 15,000 volts per IEC 801-2.
11. Mounting:
    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.

c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

12. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
13. Bypass Switch: Override the "on" function in case of sensor failure.
14. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.
15. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.

C. PIR Type: Wall or Ceiling mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).
2. Detection Coverage (Room, Ceiling Mounted): Detect occupancy anywhere in a circular area of 2000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
3. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
4. Extreme Temperature PIR types shall have operating temperatures from -40deg F to 125d F. UL Listed for damp locations. Temperature compensating circuitry to avoid false activation in extreme conditions, segmented frosted lens, Immune to RFI, EMI and voltage fluctuations.

D. Ultrasonic Type: Wall or Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
2. Utilize Doppler shift ultrasonic detection technology.
3. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
4. Detection Coverage (Corridor): Detect occupancy anywhere within 80 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).
5. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 2000 square feet (220 square meters) when mounted84 inches (2100 mm) above finished floor.

E. Dual-Technology Type: Wall of Ceiling mounted; detect occupants in coverage area using PIR and Ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
4. Incorporate Doppler shift ultrasonic and passive infrared motion detection technologies. Products that react to noise or ambient sound shall not be considered.

F. Vacancy Wall Switch/Dimmer Combinations:

1. Requires manual On to activate lighting.
2. Provide a mechanical air-gap on/off function for all sensors.
3. Capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.
4. Shall accommodate loads from 0-800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180 degree coverage capability.
5. Shall be able to have their visible plastic parts replaced, for color changes in the field, without removing the body of the control from the wall and without requiring special tools.
6. Shall have no leakage current to load, in manual or in Auto/Off mode for safety purposes and shall have voltage drop protection.
7. Shall be dual technology.

8. A Neutral shall be required.
9. Where specified as dual relay (designated as VSw2 on drawings), provide two separate buttons, one for lighting, one for motor load. Each relay can be set independently to automatic or manual on mode. Motor load relay rated for 1/4hp minimum. Motor load relay shall have adjustable time delay for 10 minutes minimum after no detection.
10. Shall have adjustable time delay.
11. Shall have self-adaptive technology.

2.2 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company.

B. Description: Electrically operated and mechanically electrically held, combination-type lighting contactors with fusible switch non-fused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings matching the NEMA type specified for the enclosure.

2.3 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

C. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies and per shop drawings.

D. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

E. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 3/4 inch (21-mm).

B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

B. Label time switches and contactors with a unique designation.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within twenty-four (24) months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide for two (2) visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls (where applicable), adjust set points and deadband controls to suit Owner's operations.
3. Submit written documentation of completion.

3.6 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Provide 8 hours of training.

END OF SECTION 26 09 23

SECTION 26 09 26 - LIGHTING CONTROL PANELS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Distributed Digital Lighting Control System, including:

1. Digital Lighting
2. Relay Panels
3. Emergency Lighting Control

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.
2. Section 260923 “Lighting Control Devices” for occupancy/vacancy sensors used in conjunction with the lighting control system.

1.3 REFERENCES

1. NFPA 70 – National Electrical Code; National Fire Protection Association
2. NEMA – National Electrical Manufacturers Association
3. FCC Emissions Standards
4. UL – Underwriters Laboratories, Inc.
5. UL 2043 – Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products Installed in Air-Handling Spaces.
6. UL 20 – General Use Switches, Plug Load Controls

1.4 DESIGN/PERFORMANCE REQUIRMENTS

A. Digital Lighting Management System shall accommodate the square-footage coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, switches, daylighting sensors and accessories that suit the required lighting and electrical system parameters.

B. System shall conform to requirements of NFPA 70.

C. System shall comply with FCC emission standards specified in part 15, sub-part J for commercial and residential application.

D. System shall be listed under UL sections 916 and/or 508.

1.5 ALTERNATE MANUFACTURERS:

A. Refer to specification section 26 51 19 – 1.3.

1.6 ACTION SUBMITTALS

A. Product Data: Manufacturer’s data sheets on each product to be used, including:

1. Catalog sheets and specifications
2. Ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
3. Storage and handling requirements and recommendations
4. Installation instructions.

B. Shop Drawings: Wiring diagrams for the various components of the System specified including:

1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.
2. Show location of all devices, including at minimum sensors, load controllers, and switches/dimmers for each area of reflected ceiling plans.
3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.
4. Low Voltage Control Stations – each button shall be engraved. Submit button labeling forms for each space and for each button configuration variation. Forms shall be provided to Architect for Ownership review and approval.

C. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual installed locations and settings for lighting control devices.

B. Operation and Maintenance Manual:

1. Include approved Shop Drawings and Product Data.
2. Include Sequence of Operation, identifying operation for each room or space.
3. Include manufacturer's maintenance information.
4. Operation and Maintenance Data: Include detailed information on device programming and setup.
5. Include startup and test reports.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing of centralized and distributed lighting control systems with a minimum of 10 years documented experience.

B. Installer Qualifications: Company certified by the manufacturer and specializing in installation of lighting control products with minimum three years documented experience.

C. System Components: Demonstrate that individual components have undergone quality control and testing prior to shipping.

1.9 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to commencing Work of this section. Meeting to be attended by General Contractor, Electrical Contractor, Architect, Lighting Designer, System installer, Factory authorized manufacturer's representative, and representative of all trades related to the system installation.

B. Review installation procedures and coordination required with related Work and the following:

1. Confirm the location and mounting of **all** devices, with special attention to placement of switches (hard wired and wireless), dimmers, and any sensors (coordinated with mechanical systems due to field adaptations).
2. Review the specifications for low voltage control wiring and termination.
3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.
4. Discuss requirements for integration with other trades
5. Review all Lighting Control Zones. General Contractor shall provide set of drawings to be utilized by Architect at meeting for confirmation of each space. Drawings shall be electronically scanned and distributed to design team and all required contractors.

C. Inspect and make notes of job conditions prior to installation:

1. General contractor shall record minutes of the conference and provide copies to all parties present.
2. Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.
3. Installation shall not begin until all outstanding issues are resolved to the satisfaction of the Architect.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.11 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Do not install equipment until following conditions can be maintained in spaces to receive equipment:

1. Ambient temperature: 32 to 104 degrees F (0 to 40 degrees C).
2. Relative humidity: Maximum 90 percent, non-condensing.

1.12 WARRANTY

A. Manufacturer's Warranty: Manufacturer shall provide a 5-year limited warranty on products within this installation, except where otherwise noted, and consisting of a one-for-one device replacement.

1.13 ADDITIONAL MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Room Controllers – Provide 1 for every 25 similar spaces. Furnish at least one (1) of each type labeled as per room being served.
   2. Low Voltage Control Station – Provide 1 for every 10 similar spaces. Button quantity, color and engraving shall match station installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: **Subject to compliance with requirements**, provide Wattstopper/Legrand; or comparable product by one of the following:
   1. Steinel/Crestron.
   2. Eaton Controls/ILC.

2.2 DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

A. Equipment required: Lighting Control and Automation system as defined under this section covers the following equipment.

   1. Digital Lighting Management (DLM) local network: Free topology, plug-in wiring system (Cat6) for power and data to room devices.
   2. Digital Occupancy Sensors: Self-configuring, digitally addressable, calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
   3. Digital Switches: Self-configuring, digitally addressable pushbutton on/off, dimming, and scene switches with two-way active infrared (IR) communications.
   4. Handheld remotes for personal control: On/Off, dimming and scene remotes for control using infrared (IR) communications. Remote may be configured in the field to control selected loads or scenes without special tools.
   5. Digital Daylighting Sensors: Single-zone open loop daylighting sensors with two-way active infrared (IR) communications for daylight harvesting using switching, bi-level, tri-level or dimming control.
   6. Digital Lighting Management Relay Panel and Zone Controller: Provides up to 8, 24, or 48 mechanically latching relays. Relays include a manual override and a single push-on connector for easy installation or removal from the panel. Panel accepts program changes from handheld configuration tool for date and time, location, holidays, event scheduling, button binding and group programming.
   7. Emergency Lighting Control Unit (ELCU): Allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building.

B. Local Network LMRJ-Series: DLM local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building.

   1. Features of the DLM local network include:

      a. Plug n' Go automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
      b. Simple replacement of any device in the local DLM network with a standard off the shelf unit without requiring significant commissioning, configuration or setup.
      c. Push n' Learn configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices in the local network.
      d. Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.

2. Digital room devices connect to the local network using pre-terminated Cat6 cables with RJ-45 connectors, which provide both data and power to room devices. Systems that utilize RJ-45 patch cords but do not provide serial communication data from individual end devices are not acceptable.
3. If manufacturer's pre-terminated Cat6 cables are not used for the installation each cable must be individually tested and observed by authorized service representative following installation.

2.3 DIGITAL LOAD CONTROLLERS (ROOM CONTROLLERS)

A. Digital Load Controllers: Digital controllers for lighting zones and fixtures automatically bind room loads to the connected control devices in the space without commissioning or the use of any tools. Provide controllers to match the room lighting. Controllers are simple to install, and do not have dip switches/potentiometers, or require special configuration for standard Plug n' Go applications. Control units include the following features:

1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room
2. Simple replacement using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf device.
3. Multiple room controllers connection together in a local network must automatically arbitrate with each other, without requiring any configuration or setup, so that individual load numbers are assigned starting with load 1 to a maximum of 64, assigned based on each controller's device ID's from highest to lowest.
   a. Alternative Manufacturers that utilize multiple power packs for room control system shall have all power packs and associated appurtenances contained with a single nema 1 enclosure. Submit enclosure size and construction at shop drawing level with this section.
4. Device Status LEDs to indicate:
   a. Data transmission.
   b. Device has power.
   c. Status for each load.
   d. Configuration status.
5. Quick installation features including
   a. Standard junction box mounting.
   b. Quick low-voltage connection using standard RJ-45 patch cable.
6. Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power.
   a. Turn on to 100 percent.
   b. Turn off.
   c. Turn on to last level.
7. Each load shall be configurable to operate in the following sequences based on occupancy:
   a. Auto-On/Auto-Off (Follow on and off)
   b. Manual-On/Auto-Off (Follow off only)
8. Polarity of each load output shall be reversible, via digital configuration, so that on is off and off is on.
9. UL 2043 plenum rated.
10. Manual override and LED indication for each load.
11. Zero cross circuitry for each load.
12. All digital parameter data programmed into an individual room controller or plug load controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.
13. Dimming Room Controllers shall share the following features:
    a. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.
    b. The following dimming attributes may be changed or selected using a wireless configuration tool:
       1) Establish preset level for each load from 0-100 percent.
       2) Set high and low trim for each load.

c. Override button for each load provides the following functions:

1) Press and release for on/off control.
2) Press and hold for dimming control.

d. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected driver. LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim.

e. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100 percent dimming range defined by the minimum and maximum calibration trim.

f. Calibration and trim levels must be set per output channel. Devices that set calibration or trim levels per controller (as opposed to per load) are not acceptable.

g. All configuration shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.

2.4 DIGITAL DAYLIGHTING SENSORS

A. Digital daylighting sensors shall work with load controllers and relay panels to provide automatic switching, bi-level, or tri-level or dimming daylight harvesting capabilities for any load type connected to the controller or panel. Daylighting sensors shall be interchangeable without the need for rewiring.

1. Closed loop sensors measure the ambient light in the space and control a single lighting zone.
2. Open loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones.
3. Dual loop sensors measure both ambient and incoming daylight in the space to insure that proper light levels are maintained as changes to reflective materials are made in a single zone

B. Digital daylighting sensors shall include the following features:

1. Senor's internal photodiode shall only measure lightwaves within the visible spectrum. The photodiode's spectral response curve shall closely match the entire photopic curve. Photodiode shall not measure energy in either the ultraviolet or infrared spectrums. Photocell shall have a sensitivity of less than 5 percent for any wavelengths less than 400 nanometers or greater than 700 nanometers.
2. Sensor light level range shall be from 1-6,553 foot-candles (fc).
3. Capability of ON/OFF, bi-level or tri-level switching, or dimming, for each controlled zone, depending on the selection of load controller(s) and load binding to controller(s).
4. For switching daylight harvesting, the photosensor shall provide a field-selectable deadband, or a separation, between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling excessively after they turn off.
5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a field-selectable minimum level.
6. Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.
7. Photosensors shall provide adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut-off.
8. Integral infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
9. Configuration LED status light on device that blinks to indicate data transmission.
10. Status LED indicates test mode, override mode and load binding.
11. Recessed switch on device to turn controlled load(s) ON and OFF.
12. BACnet object information shall be available for the following daylighting sensor objects, based on the specific photocell's settings:

a. Light level
b. Day and night setpoints
c. Off time delay
d. On and off setpoints
e. Up to three zone setpoints
f. Operating mode - on/off, bi-level, tri-level or dimming

13. One RJ-45 port for connection to DLM local network.
14. A choice of accessories to accommodate multiple mounting methods and building materials. Photosensors may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox. Standard tube photosensors accommodate mounting materials from 0-0.62 inch thick (LMLS-400, LMLS-500). Extended tube photosensors accommodate mounting materials from 0.62 to 1.25 inches thick (LMLS-400-L, LMLS-500-L). Mounting brackets are compatible with J boxes (LMLS-MB1) and wall mounting (LMLS-MB2). LMLS-600 photosensor to be mounted on included bracket below skylight well.
15. Any load or group of loads in the room can be assigned to a daylighting zone
16. Each load within a daylighting zone can be individually enabled or disabled for discrete control (load independence).
17. All digital parameter data programmed into a photosensor shall be retained in non-volatile FLASH memory within the photosensor itself. Memory shall have an expected life of no less than 10 years.

2.5 LMCP LIGHTING CONTROL PANELS AND LMZC ZONE CONTROLLER

A. Hardware: Provide LMCP lighting control panels in the locations and capacities as indicated on the Drawing and schedules. Each panel shall be of modular construction and consist of the following components:

1. Enclosure/Tub shall be NEMA 1, sized to accept an interior with 1 - 8 relays, 1 - 24 relays and 6 four-pole contactors, or 1 - 48 relays and 6 four-pole contactors.
2. Cover shall be configured for surface or flush wall mounting of the panel as indicated on the plans. LMCP panel cover shall have a hinged and lockable door with restricted access to line voltage section of the panel.
3. Interior assembly shall be supplied as a factory assembled component specifically designed and listed for field installation. Interior construction shall provide total isolation of high voltage (Class 1) wiring from low voltage (Class 2) wiring within the assembled panel. Interior assembly shall include intelligence boards, power supply, DIN rails for mounting optional Class 2 control devices, and individually replaceable latching type relays. Panel interiors shall include the following features:

   a. Removeable, plug-in terminal blocks with connections for all low voltage terminations.
   b. Individual terminal block, override pushbutton, and LED status light for each relay.
   c. Direct wired switch inputs associated with each relay shall support 2-wire momentary switches only.
   d. Digital inputs (four RJ-45 jacks) shall support 1-, 2-, 3-, 4-, and 8-button digital switches; digital IO modules capable of receiving 0-5V or 0-10V analog photocell inputs; digital IO modules capable of receiving momentary or maintained contact closure inputs or analog sensor inputs; digital daylighting sensors; and digital occupancy sensors. Inputs are divided into two separate digital networks, each capable of supplying 250mA to connected devices.
   e. True relay state shall be indicated by the on-board LED and shall be available to external control devices and systems via BACnet.
   f. Automatically sequenced operation of relays to reduce impact on the electrical distribution system when large loads are controlled simultaneously.
   g. Group and pattern control of relays shall be provided through a simple keypad interface from a handheld IR programmer. Any set of relays can be associated with a group for direct on/off control or pattern (scene) control via a simple programming sequence using the relay override pushbuttons and LED displays for groups 1-8 or a handheld IR programmer for groups 1-99.
   h. Relay group status for shall be provided through LED indicators for groups 1-8 and via BACnet for groups 1-99. A solid LED indicates that the last group action called for an ON state and relays in the group are on or in a mixed state.

4. Single-pole latching relays with modular plug-in design. Relays shall provide the following ratings and features:

   a. Electrical:

      1) 30 amp ballast at 277V
      2) 20amp tungsten at 120V
      3) 1.5 HP motor at 120V
      4) 14,000 amp short circuit current rating (SCCR) at 347V

   b. Mechanical:

1) 30 amp ballast at 277V
2) 20amp tungsten at 120V
3) 1.5 HP motor at 120V
4) 14,000 amp short circuit current rating (SCCR) at 347V

5. Isolated low voltage contacts provide for true relay status feedback and pilot light indication.
6. Power supply shall be a multi-voltage transformer assembly with rated power to supply all electronics, occupancy sensors, switches, pilot lights, and photocells as necessary to meet the project requirements. Power supply to have internal over-current protection with automatic reset and metal oxide varistor protection.
7. Where indicated, lighting control panels designated for control of emergency lighting shall be provided with factory installed provision for automatic by pass of relays controlling emergency circuits upon loss of normal power. Panels shall be properly listed and labeled for use on emergency lighting circuits and shall meet the requirements of UL924 and NFPA 70 - Article 700. All emergency fixtures being dimmed under normal power shall go to full brightness.
8. Integral system clock shall provide scheduling capabilities for panel-only projects without DLM segment networks or BAS control.

   a. Each panel shall include digital clock capability able to issue system wide automation commands to up to 11 other panels for a total of 12 networked lighting control panels. Clock shall provide capability for up to 254 independent schedule events per panel for each of the ninety-nine system wide channel groups.
   b. Clock capability of each panel shall support the time-based energy saving requirements of applicable local energy codes.
   c. Clock module shall provide astronomic capabilities, time delays, blink warning, daylight savings, and holiday functions and will include a battery back up for clock function and program retention in non-volatile FLASH memory. Clocks that require multiple events to meet local code lighting shut off requirements shall not be allowed.
   d. Clock capability of each panel shall operate on a basis of ON/OFF or Normal Hours/After Hours messages to automation groups that implement pre-configured control scenarios. Scenarios shall include:

      1) Scheduled ON / OFF
      2) Manual ON / Scheduled OFF
      3) Astro ON / OFF (or Photo ON / OFF)
      4) Astro and Schedule ON / OFF (or Photo and Schedule ON / OFF)

   e. User interface shall be portable IR handheld remote control capable of programming any panel in the system
   f. Clock capability of each panel shall employ non-volatile memory and shall retain user programming and time for a minimum of 10 years.
   g. Schedules programmed into the clock of any one panel shall be capable of executing panel local schedule or Dark/Light (photocell or Astro) events for that panel in the event that global network communication is lost. Lighting control panels that are not capable of executing events independently of the global network shall not be acceptable.

9. Lighting control panel can operate as a stand-alone system, or can support schedule, group, and photocell control functions, as configured in a Segment Manager controller, via a segment network connection.
10. Lighting control panel shall support digital communications to facilitate the extension of control to include interoperation with building automation systems and other intelligent field devices. Digital communications shall be RS485 MS/TP-based using the BACnet protocol.

    a. Panel shall have provision for an individual BACnet device ID and shall support the full 222 range (0 - 4,193,304). The device ID description property shall be writable via the network to allow unique identification of the lighting control panel on the network.
    b. Panel shall support MS/TP MAC addresses in the range of 0 - 127 and baud rates of 9600k, 38400k, 76800k, and 115.2k bits per second.
    c. Lighting control relays shall be controllable as binary output objects in the instance range of 1 - 64. The state of each relay shall be readable and writable by the BAS via the object present value property.
    d. Lighting control relays shall report their true on/off state as binary input objects in the instance range of 1 - 64.
    e. The 99 group Normal Hours/After Hours control objects associated with the panel shall be represented by binary value objects in the instance range of 201 - 299. The occupancy state

of each channel group shall be readable and writable by the BAS via the object present value property. Commanding 1 to a channel group will put all relays associated with the channel into the normal hours mode. Commanding 0 or NULL shall put the relays into the after hours mode.

f. Setup and commissioning of panel shall not require manufacturer-specific software or a computer. All configuration of the lighting control panel shall be performed using standard BACnet objects or via the handheld IR programming remote. Provide BACnet objects for panel setup and control as follows:

1) Binary output objects in the instance range of 1 - 64 (one per relay) for on/off control of relays.
2) Binary value objects in the instance range of 1 - 99 (one per channel) for normal hours/after hours schedule control.
3) Binary input objects in the instance range of 1 - 64 (one per relay) for reading true on/off state of the relays.
4) Analog value objects in the instance range of 101 - 199 (one per channel group) shall assign a blink warn time value to each channel. A value of 5 shall activate the blink warn feature for the channel and set a 5-minute grace-time period. A value of 250 shall activate the sweep feature for the channel and enable the use of sweep type automatic wall switches.

11. In addition to the LMCP Relay Panels, an LMZC Zone Controller panel shall be available for zero-relay applications. The panel is designed for applications where LMFC-011 Fixture Controllers or other distributed load controllers are used to switch and/or dim the controlled loads. Key similarities to and differences from the LMCP panel design shall include:

a. Use the same intelligence board as the LMCP relay panel.
b. Shall not include relay driver boards or relays.
c. Have a removable interior section to facilitate installation, and a Tub/Cover. Cover is for surface mounting applications only.
d. Tub shall have two interior KOs to allow installation of LMPB-100 Power Boosters. Each installed Power Booster can provide an additional 150 mA for either of the two available DLM local networks provided by the LMZC.
e. All programming and networking (whether DLM Local Network and/or Segment Network) capabilities in the LMZC Zone Controller shall be similar to capabilities for LMCP relay panels, except for functions designed for panel-mounted HDR relays.

12. To aid in project start up, if LMFC Fixture Controllers are connected to an LMZC Zone Controller, Plug n' Go automatic configuration will establish a unique sequence of operation so that all LMFC-controlled fixtures will turn on to 50 percent output when any digital occupancy sensor detects motion.

B. User Interface: Each lighting control panel system shall be supplied with at least one handheld configuration tool. As a remote programming interface, the configuration tool shall allow setup, configuration, and diagnostics of the panel without the need for software or connection of a computer. User interface shall have the following panel-specific functions as a minimum:

1. Button binding of digital switches to groups shall be accessible via the handheld IR remote and accomplished from the digital switch station.
2. Programming of panel location information shall be accomplished by the handheld IR remote and include at a minimum LAT, LON, DST zone, and an approximate city/state location.

2.6 EMERGENCY LIGHTING CONTROL DEVICES

A. Emergency Lighting Control Unit - A UL 924 listed device that monitors a switched or dimmed circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:

1. 120/277 volts, 50/60 Hz, 20-amp ballast rating
2. Push to test button
3. Auxiliary contact for remote test or fire alarm system interface
4. Shall disconnect 0-10v control wiring turning light fixture to full brightness.

PART 3 - EXECUTION

3.1 PREPARATION

A. Do not begin installation until measurements have been verified and work areas have been properly prepared.

B. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that required pre-installation meeting specified in Part 1 of this specification has been completed, recorded meeting minutes have been distributed and all outstanding issues noted have been resolved prior to the start of installation.

3.2 INSTALLATION

A. Install system in accordance with the approved system shop drawings and manufacturer's instructions.

B. Install all room/area devices using manufacturer's factory-tested Cat6 cable with pre-terminated RJ-45 connectors.

1. If fixtures have internal DLM Control Modules, ensure that they are also connected with Cat6 cable.
2. Low voltage wiring topology must comply with manufacturer's specifications.

C. All line voltage connections shall be tagged to indicate circuit and switched legs.

D. Test all devices to ensure proper communication.

E. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lighted while occupied.

F. Provide written or computer-generated documentation on the configuration of the system including room by room description including:

1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
3. Load Parameters (e.g. blink warning, etc.)

G. Post start-up tuning - Adjust sensor time delays and sensitivities to meet the Owner's requirements 30 days from beneficial occupancy. Provide a detailed report to the Architect / Owner of post start-up activity.

H. Tighten all panel Class I conductors from both circuit breaker and to loads to torque ratings as marked on enclosure UL label.

I. All Class II cabling shall enter enclosures from within low-voltage wiring areas and shall remain within those areas. No Class I conductors shall enter a low-voltage area.

J. Run separate neutrals for any phase dimmed branch load circuit. Different types of dimming loads shall have separate neutral.

K. Verify all non-panel-based lighting loads to be free from short circuits prior to connection to room controllers.

3.3 FIELD QUALITY CONTROL

A. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Notify Architect, Lighting Designer and Manufacturer in writing a minimum of 3 weeks prior to system start-up and testing.

B. Tests and Inspections: Manufacturer's service representative shall perform the following inspections and prepare reports.

1. Verify Class I and II wiring connections are terminated properly by validating system performance.
2. Set IP addresses and other network settings of system front end hardware per facilities IT instructions.
3. Verify / complete task programming for all switches, dimmers, time clocks, and sensors.
4. Verify that the control of each space complies with the Sequence of Operation.
5. Correct any system issues and retest.

C. Provide a report in table format with drawings, or using a software file that can be opened in the manufacturer's system software including each room or space that has lighting control installed. Indicate the following:

1. Date of test or inspection.
2. Loads per space, or Fixture Address identification.
3. Quantity and Type of each device installed
4. Reports providing each device's settings.

3.4 DEMONSTRATE AND TRAINING

A. Before Substantial Completion, arrange and provide two separate training session (min. of 4 hours each) for Owner instruction period to designated Owner personnel. Set-up, starting of the lighting control system and Owner instruction includes:

1. Confirmation of entire system operation and communication to each device.
2. Confirmation of operation of individual relays, switches, and sensors.
3. Confirmation of system Programming, photocell settings, override settings, etc.
4. Provide training to cover installation, programming, operation, and troubleshooting of the lighting control system.

3.5 PRODUCT SUPPORT AND SERVICE

A. Factory telephone support shall be available at no cost to the Owner following acceptance. Factory assistance shall consist of assistance in solving application issues pertaining to the control equipment.

END OF SECTION 26 09 26

SECTION 26 24 13 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Surge suppression devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.
7. Identification.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Detail utility company's metering provisions with indication of approval by utility company.
6. Include evidence of NRTL listing for series rating of installed devices.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
9. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Testing Agency: Contractor shall perform field quality-control testing

C. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Comply with NEMA PB 2.

G. Comply with NFPA 70.

H. Comply with UL 891.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards and install temporary electric heating (250 W per section) to prevent condensation.

C. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.7 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is

operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

   a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
   b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 2, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

1.8 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating LED Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide only product listed:

1. Square D.
2. Siemens
3. Eaton
4. ABB

B. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

C. Nominal System Voltage: As noted on the Drawings.

D. Main-Bus Continuous: As noted on the Drawings.

E. Indoor Enclosures: Steel, NEMA 250, Type 1.

F. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

G. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.

H. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks.

I. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

J. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated**,** with copper feeder circuit-breaker line connections.
2. Ground Bus: 1/4-by-2-inch- (6-by-50-mm-), hard-drawn copper of 98 percent conductivity, equipped with compression connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
3. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
4. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical or compression connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.

K. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.2 SURGE PROTECTION DEVICES

A. See Division 26 Section: “Surge Protection for Low Voltage Electrical Power Circuits, Section “Service Entrance”.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 100 A through 225A, field-adjustable, short-time and continuous current settings for circuit-breaker frame sizes 250A through 400A.

2. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings for circuit breaker frame sizes 600A or larger:

a. Instantaneous trip.
b. Long- and short-time pickup levels.
c. Long- and short-time time adjustments.
d. Ground-fault pickup level, time delay, and I^2t response.

3. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor material.
c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

B. Fuses are specified in Division 26 Section "Fuses."

2.4 INSTRUMENTATION

A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:

1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; wound type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:

a. Phase Currents, Each Phase: Plus or minus 1 percent.
b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
d. Megawatts: Plus or minus 2 percent.
e. Megavars: Plus or minus 2 percent.
f. Power Factor: Plus or minus 2 percent.
g. Frequency: Plus or minus 0.5 percent.
h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.

2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

3. The power meter shall communicate utilizing ModBus over IP. The manufacture shall provide any gateway, etc. as required to meet this requirement. Coordinate communications with the BMS installer. The contractor shall provide a data jack per the communications specifications at the power meter and connect.

2.5 CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

2.7 IDENTIFICATION

A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to switchboards.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

E. Install filler plates in unused spaces of panel-mounted sections.

F. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

G. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.

c. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Switchboard will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories**,** and to use and reprogram microprocessor-based trip, monitoring, and communication units.

END OF SECTION 26 24 13

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include wiring diagrams for power, signal, and control wiring.
7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Include selectable ranges for each type of overcurrent protective device.

C. Qualification Data: For qualified testing agency.

D. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Panelboard Schedules: Submit final versions after load balancing.

F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.7 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than fifteen (15) days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.
3. Comply with NFPA 70E.

1.8 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Flush- and surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Outdoor Locations: NEMA 250, Type 3R.
c. Wet or Damp Indoor Locations: NEMA 250, Type 4.
d. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.

5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
6. Finishes:

    a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    b. Back Boxes: Galvanized steel.

1. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover. Handwritten cards are prohibited.
2. Multiple-Section Panelboards shall consist of two or more cabinets with identical interiors mounted under separate trims. Cabinets, trim, and doors shall be of the same size. Main lugs and busses of each section shall be rated as indicated on the Drawings. Where main breakers are indicated in multi-section panelboards, the main breaker shall be contained in one section with through-feed lugs and sub-feed cables installed within panel, equal to the incoming feeder size. All busses and lugs shall have ampere capacity equal to or greater than the main breaker ampere rating. Loads shall be divided as evenly as practical between the sections, in addition to being balanced over the phases..

B. Incoming Mains Location: Top and bottom.

C. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Compression type.
3. Ground Lugs and Bus-Configured Terminators: Compression type.
4. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
6. Gutter-Tap Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Series-rated panels will not be acceptable.

2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Siemens Power Transmission & Distribution, Inc.
2. Square D
3. Eaton
4. ABB

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Mains: Circuit breaker or Lugs only, as indicated.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Siemens Power Transmission & Distribution, Inc.
2. Square D
3. Eaton
4. ABB

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only, as indicated.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Siemens Power Transmission & Distribution, Inc.
2. Square D
3. Eaton
4. ABB

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
3. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
4. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

2.5 LIFE-SAFETY PANELBOARDS (FUSED)

A. Life-Safety (Emergency) Panelboards are fed on the load side of ATS-1.

B. Products: Subject to compliance with requirements, provide one of the following:

1. ABB – General Electrification Products.
2. Eaton; Cooper-Bussman Fusible Panelboard.
3. Square D; by Schneider Electric; Mission Critical Circuit Breaker.
4. Littlefuse
5. Mersen
6. SIEMENS Industry, Inc.; Energy Management Division; Fusible Quik-Spec Panelboard

C. Selective Coordination:

1. Life Safety Panelboards main overcurrent protective devices shall be selectively coordinated with all supply-side overcurrent protective devices per NEC Article 700.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

D. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

E. Install filler plates in unused spaces.

F. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

H. Comply with NECA 1.

I. All distribution panels shall be installed on galvanized formed steel channels designed to distribute the weight on the supporting wall.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 16075, "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 16075, "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 16075, "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

F. Panelboards will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Snap switches.
4. Pendant cord-connector devices.
5. Cord and plug sets.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

D. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.

E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STRAIGHT-BLADE RECEPTACLES

A. Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Pass & Seymour; 5361 (single), 5362 (duplex).
2. Cooper.
3. Hubbell.
4. Leviton.

B. Tamper Resistant Convenience Receptacles, 125V, 20A: Comply with NEMA WD1, NEMA WD6 configuration 5-20R, UL498 and FS W-C-596.

1. Pass & Seymour; 5361 (single), 5362 (duplex).
2. Cooper.
3. Hubbell.
4. Leviton.

C. Water Resistant Convenience Receptacles, 125V, 20A: Comply with NEMA WD1, NEMA WD6 configuration 5-20R, UL498 and FS W-C-596

1. Pass & Seymour; TR5361 (single), TR5362).
2. Cooper.
3. Hubbell.
4. Leviton.

D. Dual-Controlled Convenience

1. Convenience: Legrand 26352CD or equal by Cooper, Hubbell or Leviton.
2. Tamper Resistant: Legrand TR26352CD or equal by Cooper, Hubbell or Leviton.
   a. Controlled receptacle marking permanently printed, molded or stamped on the face of the receptacle.
   b. Markings comply with Article 406.3€ of the National Electrical Code.

2.3 USB CHARGER DEVICES

A. Tamper-Resistant, USB Charger Receptacles, 125 V, 20 A and a minimum charging output of 3.1 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, UL 1310, and FS W-C-596.

1. Pass & Seymour; TR20USBAC6 (duplex).
2. Cooper.
3. Hubbell.
4. Leviton.

2.4 GFCI RECEPTACLES

A. General Description: Straight blade, non-feed-through-type. Comply with NEMA WD 1, MENA WD 6, UL 498, Federal Specification W-C-596, and UL943, Class A. Include indicator light that is lighted when device is tripped. Must have Self-test feature (conducts and automatic test every three seconds, ensuring ground fault protection. If ground fault protection is compromised, power to the receptacle must be discontinued.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A. Comply with NEMA WD1, NEMA WD6 configuration 5-20R, UL 498, Federal Specification W-C-596 and UL 943, Class A, and include indicator light that is lighted when device is tripped. Conducts and automatic test every three seconds, ensuring ground fault protection. If protection is lost, power to the unit is disconnected and indicator light flashes indicating that the unit should be replaced.

1. Pass & Seymour; 2097 (duplex).
2. Cooper
3. Hubbell
4. Leviton.

C. Tamper-Resistant, Duplex GFCI Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD1, NEMA WD6 configuration 5-20R, UL 498, Federal Specification W-C-596 and UL943, Class A, and include indicator light that is lighted when device is tripped. Conducts an automatic test every three seconds, ensuring ground fault protection. If protection is lost, power to the unit is disconnected and indicator light flashes indicating that the unit should be replaced.

1. Pass & Seymour; 2097TR (duplex).
2. Cooper.
3. Hubbell.
4. Leviton.

2.5 LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125V, 20A: Comply with NEMA WD1, NEMA WD6 configuration L5-20R and UL498.

1. Pass & Seymour; L520R.

2. Cooper; L520R.
3. Hubbell; HBL2310.
4. Leviton; 2310

2.6 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle both connector; NEMA WD6 configurations L5-20P and L5-20R, heavy-duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provisions for attaching external grip.

a. L520 Plug: Pass & Seymour L520P
b. L520R Connector: Pass & Seymour L520C.

2.7 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-coper conductors, with Type SOW-A jacket; with green insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.

2. Plug: Nylon bod and integral cable-clamping joints. Match cord and receptacle type for connection.

2.8 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider toggle switch; with single-pole or three-way switching. Comply with UL 1472.

C. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; 1200va rated, 0-10v dimming, rocker switch with slide dimmer, designed for LED power supplies, 3-way compatible, capable of consistent dimming with low end not greater than 10 percent of full brightness, flicker free. Leviton IP710-LF series or approved equals.

2.9 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch- (1-mm-) thick, satin-finished, Type 302 stainless steel, or per Architect.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.10 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: Ivory.
2. Wiring Devices Connected to Emergency Power System: Red; with “Emergency Power” engraved on wall plate.
3. Controlled Wiring Devices: Gray; with “Switched” engraved on wall plate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.
2. Install neutral side up of horizontally mounted receptacles.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

A. Comply with Section 16075, "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 26 27 26

SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, enclosed controllers and motor-control centers.
2. Spare-fuse cabinets.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

   a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
   b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Coordination charts and tables and related data.

B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Coordination charts and tables and related data.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:
   1. Feeders: Class J, time delay.
   2. Motor Branch Circuits: Class RK1, time delay.
   3. Other Branch Circuits: Class RK1, time delay.
   4. Control Circuits: Class CC, time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 16075, "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 28 13

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Qualification Data: For qualified testing agency.

D. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Submit on translucent log-log graph paper.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than fifteen (15) days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Siemens Power Transmission & Distribution, Inc.
2. Square D
3. Eaton
4. ABB

B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle (either open or closed position) with capability to accept three padlocks, and interlocked with cover in closed position.

A. Accessories (Required per device):

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Compression type, suitable for number, size, and conductor material.

B. Optional Accessories (As specified on Drawings):

1. Auxiliary Contact Kit: One NO/NC (Form “C”) auxiliary. Contacts would reactivate before blades open as indicated on the Drawings.
2. Accessory Control Power Voltage: Remote-mounted and powered; 120-VAC. Provide as required with auxiliary contact kit.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Siemens Power Transmission & Distribution, Inc.
2. Square D
3. Eaton
4. ABB

B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

A. Accessories (Required per device):

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Lugs: Compression type, suitable for number, size and conductor material.

B. Optional Accessories (As specified on Drawings):
1. Auxiliary Contact Kit: One NO/NC (Form “C”) auxiliary contacts, arranged to activate before switch blades open, where indicated in the Drawings.
2. Accessory Control Power Voltage: Remote mounted and powered; 120 VAC. Provide as required with auxiliary contact kit.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Siemens Power Transmission & Distribution, Inc.
2. Square D
3. Eaton
4. ABB

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
7. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
8. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Section 16071 "Hangers and Supports for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 16075, "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 26 28 16

SECTION 26 29 13 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes ac, enclosed controllers rated 600 V and less, of the following types:

1. Across-the-line, manual and magnetic controllers.
2. Reduced-voltage controllers.
3. Multispeed controllers.

B. Related Sections include the following:

1. Division 23 Sections for “Variable-Frequency Motor Controllers” and “Power Factor Correction Capacitors”.

1.3 SUBMITTALS

A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each enclosed controller.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.
b. Nameplate legends.
c. Short-circuit current rating of integrated unit.
d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.

2. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around enclosed controllers where pipe and ducts are prohibited. Show enclosed controller layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

D. Qualification Data: For manufacturer and testing agency.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for enclosed controllers and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

G. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed controllers, minimum clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas su

C. bject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner no fewer than fifteen (15) days in advance of proposed interruption of electrical service.
2. Indicate method of providing temporary utilities.
3. Do not proceed with interruption of electrical service without Owner's written permission.

1.7 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

C. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.

D. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Spare Fuses: Furnish one spare for every five installed, but no fewer than one set of three of each type and rating.
2. Indicating Lights: Two of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Siemens Power Transmission & Distribution, Inc.
2. Square D
3. Eaton
4. ABB

2.2 ACROSS-THE-LINE ENCLOSED CONTROLLERS

A. Manual Controller: NEMA ICS 2, general purpose, Class A, with "quick-make, quick-break" toggle or pushbutton action, and marked to show whether unit is "OFF," "ON," or "TRIPPED."

1. Overload Relay: Ambient-compensated type with inverse-time-current characteristics and NEMA ICS 2, Class 10 tripping characteristics. Relays shall have heaters and sensors in each phase, matched to nameplate, full-load current of specific motor to which they connect and shall have appropriate adjustment for duty cycle.

B. Magnetic Controller: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.

1. Control Circuit: 120 V; obtained from integral control power transformer of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
2. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class 20 tripping characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.

C. Combination Magnetic Controller: Factory-assembled combination controller and disconnect switch or circuit breaker, or noted on the Drawings..
   1. Nonfusible Disconnecting Means: NEMA KS 1, heavy-duty, nonfusible switch.
   2. Circuit Breaker: Thermal magnetic.

2.3 REDUCED-VOLTAGE ENCLOSED CONTROLLERS

A. Autotransformer Reduced-Voltage Controller: NEMA ICS 2, closed transition.

2.4 MULTISPEED ENCLOSED CONTROLLERS

A. Multispeed Enclosed Controller: Match controller to motor type, application, and number of speeds; include the following accessories:

   1. Compelling relay to ensure that motor will start only at low speed.
   2. Accelerating relay to ensure properly timed acceleration through speeds lower than that selected.
   3. Decelerating relay to ensure automatically timed deceleration through each speed.

2.5 ENCLOSURES

A. Description: Flush- or surface-mounting cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.

   1. Outdoor Locations: NEMA 250, Type 3R.
   2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2.6 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-to-test Red “Power Available” and Green “Running” non-incandescent pilot lights and Hand-Off-Automatic selector switches, NEMA ICS2, heavy-duty type.

C. Control Relays: Two (2) NO/NC auxiliary contacts and adjustable time-delay relays, as required by automation and control sequences.

D. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.

2.7 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested enclosed controllers before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

A. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 16071, "Hangers and Supports for Electrical Systems."

B. Install freestanding equipment on concrete bases.

C. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Section 16475, "Fuses."

D. Install Power Factor Correction Capacitors furnished under Division 23 with disconnects, overcurrent protection, wire, conduit and ground for capacitor enclosure, all in accordance with the recommendations of the capacitor manufacturer and the National Electric Code.

3.4 IDENTIFICATION

A. Identify enclosed controller, components, and control wiring according to Section 16075, "Identification for Electrical Systems."

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers according to Section 16120, "Low-Voltage Electrical Power Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where applicable.

1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
2. Connect selector switches with enclosed controller circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

A. Conduit installation requirements are specified in other Division 16 Section, 16130. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment according to Section 16452, "Grounding and Bonding for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Assist in field testing of equipment including pretesting and adjusting of solid-state controllers.
3. Report results in writing.

C. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

D. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS, "Motor Control - Motor Starters." Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.8 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 26 29 13

SECTION 26 32 13 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Generator shall be installed in dedicated generator room in lower level of building. Coordination with rigging company is critical to remove parts of unit to fit thru a 48” high opening. Generator room has limitations on air flow for cooling and combustion air. Generator shall have a maximum combined ventilation and combustion air flow of 11,500 cfm.

B. This Section includes packaged engine-generator sets for emergency power supply with the following features:

1. Gas engine.
2. Unit-mounted cooling system.
3. Unit-mounted and Remote-mounted control and monitoring.
4. Performance requirements for sensitive loads.

C. Related Sections include the following:

1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Thermal damage curve for generator.
2. Time-current characteristic curves for generator protective device.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.

4. Wiring Diagrams: Power, signal, and control wiring.
5. Plan showing parts that will need to be removed for rigging into the basement level of the building and how this will be coordinated with rigging company.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that engine-generator set, batteries, battery racks, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Qualification Data: For installer, manufacturer and testing agency.

C. Source quality-control test reports.

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
5. Report of sound generation.
6. Report of exhaust emissions showing compliance with applicable regulations.
7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

D. Field quality-control test reports.

E. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.

3. Filters: One sets each of lubricating oil, fuel, and combustion-air filters.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1. Maintenance Proximity: Not more than three hours' normal travel time from Installer's place of business to Project site.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles (321 km) of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Comply with ASME B15.1.

G. Comply with NFPA 37.

H. Comply with NFPA 70.

I. Comply with NFPA 110 requirements for Level 1 emergency power supply system.

J. Comply with UL 2200.

K. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

L. Noise Emission: Comply with applicable state and local government requirementsfor 50dBA maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.9 PROJECT CONDITIONS

A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: Minus 15 to plus 40 deg C.
2. Relative Humidity: 0 to 95 percent.
3. Altitude: Sea level to 1000 feet (300 m).

1.10 COORDINATION

A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.12 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Kohler Co.; or a comparable product by one of the following:

1. Caterpillar; Engine Div.
2. Cummins Power Generation.
3. Spectrum Detroit Diesel (MTU).

2.2 ENGINE-GENERATOR SET

A. Factory-assembled and -tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.

1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

C. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing.
2. Output Connections: Three-phase, four wire.
3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: Comply with NFPA 110, Type 10, system requirements.

E. Generator-Set Performance for Sensitive Loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.

    a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.

2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.

    a. Provide permanent magnet excitation for power source to voltage regulator.

10. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

A. Fuel: Natural gas.

B. Rated Engine Speed: 1800 rpm.

C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).

D. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Engine Fuel System:

1. Natural Gas System:

a. Carburetor.
b. Secondary Gas Regulator.
c. Fuel-Shutoff Solenoid Valve.
d. Flexible Fuel Connector.

F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

G. Governor: Adjustable isochronous, with speed sensing.

H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.

a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and no collapsible under vacuum.
b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.
2. Sound level measured at a distance of 10 feet (3 m) from exhaust discharge after installation is complete shall be 85 dBA or less.

J. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

K. Starting System: 24-V electric, with negative ground.

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: As required by NFPA 110 for system level specified.

4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least twice without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:

    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
    c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
    e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
    f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

B. Configuration: Operating and safety indications, protective devices, basic system controls, engine gages, instrument transformers, generator disconnect switch or circuit breaker, and other indicated components shall be grouped in a combination control and power panel. Control and monitoring section of panel shall be isolated from power sections by steel barriers. Panel features shall include the following:

    1. Wall-Mounting Cabinet Construction: Rigid, self-supporting steel unit complying with NEMA ICS 6. Power bus shall be copper. Bus, bus supports, control wiring, and temperature rise shall comply with UL 891.
    2. Current and Potential Transformers: Instrument accuracy class.

C. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1system, and the following:

    1. AC voltmeter.
    2. AC ammeter.
    3. AC frequency meter.
    4. DC voltmeter (alternator battery charging).
    5. Engine-coolant temperature gage.
    6. Engine lubricating-oil pressure gage.
    7. Running-time meter.
    8. Ammeter-voltmeter, phase-selector switch(es).

9. Generator-voltage adjusting rheostat.
10. Generator overload.
11. Start-stop switch.
12. Overspeed shutdown device.
13. Coolant high-temperature shutdown device.
14. Coolant low-level shutdown device.
15. Oil low-pressure shutdown device.

D. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

E. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Division 26 Section "Electrical Power Monitoring and Control."

F. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.

1. Overcrank shutdown.
2. Coolant low-temperature alarm.
3. Control switch not in auto position.
4. Battery-charger malfunction alarm.
5. Battery low-voltage alarm.

G. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.

1. Engine high-temperature shutdown.
2. Lube-oil, low-pressure shutdown.
3. Overspeed shutdown.
4. Remote emergency-stop shutdown.
5. Engine high-temperature prealarm.
6. Lube-oil, low-pressure prealarm.
7. Low coolant level.

H. Remote Alarm Annunciator: An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

I. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.5 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Disconnect Switch: Molded-case type, 100 percent rated.

1. Rating: Matched to generator output rating.
2. Shunt Trip: Connected to trip switch when signaled by generator protector or by other protective devices.

B. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a

shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:

1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

C. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.6 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Enclosure: Dripproof.

G. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.

1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

H. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

J. Subtransient Reactance: 12 percent, maximum.

2.7 MOTORS

A. General requirements for motors are specified in Division 25 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.

2.8 VIBRATION ISOLATION DEVICES

A. Restrained Spring Isolators: Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Isolation Technology, Inc.
d. Kinetics Noise Control, Inc.
e. Mason Industries, Inc.
f. Vibration Eliminator Co., Inc.
g. Vibration Isolation.
h. Vibration Mountings & Controls, Inc.

2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.

a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.9 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.10 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Full load run.
3. Maximum power.
4. Voltage regulation.
5. Transient and steady-state governing.
6. Single-step load pickup.
7. Safety shutdown.
8. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Contractor shall coordinate with authorized generator distributor to remove all parts required to accommodate rigging of generator into basement of building. After generator is rigged into place, authorized generator distributor shall re-install parts and restore generator to working order and certify the unit. Warranty on unit shall be honored.

B. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

C. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

D. Install packaged engine generator on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section "Cast-in-Place Concrete."

1. Comply with requirements for seismic control devices specified in Division 26 Section "Seismic Controls for Electrical Systems."
2. Comply with requirements for vibration isolation devices specified in this section.

E. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet. Flexible connectors and steel piping materials and installation requirements are specified in Division 25.

1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints. Flexible connectors and piping materials and installation requirements are specified in Division 25.

F. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

A. requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.

B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.

C. Connect engine exhaust pipe to engine with flexible connector.

D. Connect fuel piping to engines with a gate valve and union and flexible connector.
1. Natural-gas piping, valves, and specialties for gas distribution are specified in Division 25.

E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

A. Identify system components according to Division 25 and Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

C. Tests and Inspections:

1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

    a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    c. Verify acceptance of charge for each element of the battery after discharge.
    d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Exhaust Emissions Test: Comply with applicable government test criteria.
7. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
8. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
9. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations 23 feet (10 meters), and compare measured levels with required values.

D. Coordinate tests with tests for transfer switches and run them concurrently.

E. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

F. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

G. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

H. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

I. Remove and replace malfunctioning units and retest/reinspect as specified above.

J. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

K. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 1 "Demonstration and Training."

END OF SECTION 26 32 13

SECTION 26 36 00 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:

1. Automatic transfer switches.
2. Remote annunciation systems.

B. Related Sections include the following:
1. Division 26 Section "Engine Generator".

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

C. Qualification Data: For manufacturer and testing agency.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Features and operating sequences, both automatic and manual.
2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than four hours from time of notification.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain automatic transfer switches, remote annunciators and packaged engine generator through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NEMA ICS 1.

F. Comply with NFPA 70.

G. Comply with NFPA 110.

H. Comply with UL 1008 unless requirements of these Specifications are stricter.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Contactor Transfer Switches:
   a. Emerson; ASCO Power Technologies, LP.
   b. Russell Electric.
   c. Kohler Co.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

G. Neutral Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.

H. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

I. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

J. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

K. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC OPEN TRANSITION TYPE TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

D. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

E. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

F. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

G. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit inrush and seal currents are rated for actual currents to be encountered.

H. Automatic Transfer-Switch Features:

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.

3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
10. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
11. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is not available.

2.4 REMOTE ANNUNCIATOR SYSTEM

A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:

1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
2. Switch position.
3. Switch in test mode.
4. Failure of communication link.

B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.

1. Indicating Lights: Grouped for each transfer switch monitored.
2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
3. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.
4. Lamp Test: Push-to-test or lamp-test switch on front panel.

2.5 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Annunciator and Control Panel Mounting: Flush in wall, or wall-mount, unless otherwise indicated on Drawings.

B. Identify components according to Division 26 Section "Identification for Electrical Systems."

C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Manufacturer’s Field Service – Tests and Inspections:

1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

    a. Check for electrical continuity of circuits and for short circuits.
    b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
    c. Verify that manual transfer warnings are properly placed.
    d. Perform manual transfer operation.

4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    b. Simulate loss of phase-to-ground voltage for each phase of normal source.

c. Verify time-delay settings.
d. Verify pickup and dropout voltages by data readout or inspection of control settings.
e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

a. Verify grounding connections and locations and ratings of sensors.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Demonstration and Training."

B. Coordinate this training with that for generator equipment.

END OF SECTION 26 36 00

SECTION 26 41 13 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes lightning protection for structures, structure elements and building site components under an Add Alternate.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For air terminals and mounting accessories.

1. Layout of the lightning protection system, along with details of the components to be used in the installation.
2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and manufacturer. Include data on listing or certification by UL.

B. Certification, signed by Contractor, that roof adhesive is approved by manufacturer of roofing material.

C. Field quality-control reports.

D. Comply with recommendations in NFPA 780, Annex D, "Inspection and Maintenance of Lightning Protection Systems," for maintenance of the lightning protection system.

E. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features, including the following:

1. Ground rods.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Certified by UL, trained and approved for installation of units required for this Project.

B. System Certificate:

1. UL Master Label.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

1.6 COORDINATION

A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.

B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.

C. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

PART 2 - PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Comply with UL 96 and NFPA 780.

B. Roof-Mounted Air Terminals: NFPA 780, Class I copper unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. East Coast Lightning Equipment Inc.
b. ERICO International Corporation.
c. Harger.
d. Heary Bros. Lightning Protection Co. Inc.
e. Independent Protection Co.
f. Preferred Lightning Protection.
g. Robbins Lightning, Inc.
h. Thompson Lightning Protection, Inc.

2. Air Terminals More than 24 Inches (600 mm) Long: With brace attached to the terminal at not less than half the height of the terminal.
3. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in roofing Sections.

C. Main and Bonding Conductors: Copper.

D. Down Conductors: Copper.

E. Ground Rods: Copper-clad steel,3/4 inch (19 mm) in diameter by 10 feet (3 m) long.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lightning protection components and systems according to UL 96A and NFPA 780.

B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends.

C. Conceal the following conductors:

1. System conductors.
2. Down conductors.
3. Interior conductors.
4. Conductors within normal view of exterior locations at grade within 200 feet (60 m) of building.

D. Cable Connections: Use exothermic-welded connections for all conductor splices and connections between conductors and other components.

1. Exception: In single-ply membrane roofing, exothermic-welded connections may be used only below the roof level.

E. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.

F. Bond extremities of vertical metal bodies exceeding 60 feet (18 m) in length to lightning protection components.

G. Ground Loop: Install ground-level, potential equalization conductor and extend around the perimeter of structure.

1. Bury ground ring not less than 24 inches (600 mm) from building foundation.
2. Bond ground terminals to the ground loop.
3. Bond grounded building systems to the ground loop conductor within 12 feet (3.6 m) of grade level.

H. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60-foot (18-m) intervals.

3.2 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260500 "Basic Electrical Materials and Methods."

3.3 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

3.4 FIELD QUALITY CONTROL

A. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.

B. UL Inspection: Meet requirements to obtain a UL Master Label for system.

END OF SECTION 26 41 13

SECTION 26 43 13 - SURGE PROTECTION DEVICES (SPD)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes field mounted SPDs for low-voltage (120V to 600V) power distribution and control equipment.

1.3 LISTING REQUIREMENTS

A. UL 1449 Third Edition listed.

1.4 SUBMITTALS

A. Drawings: Electrical and mechanical drawings shall be provided by the manufacturer which show unit dimensions, weights, mounting provisions, connection notes, wire size and wiring diagram.

B. Equipment Manual: The manufacturer shall furnish an installation manual with installation notes, start-up and operating instructions for the specified SPD. Installation instructions shall clearly state whether the system requires an external overcurrent device to maintain the system's UL 1449 listing.

C. Verification that all SPD are UL tested and labeled with 20kA (In) nominal discharge rating for compliance to UL96A Lightning Protection Master Label and NFPA 780.

D. UL 1449 stipulation for fused SPD – The manufacturer's authorized representative is required to submit the following:

1. Certify that the SPD is UL 1449 listed (UL Card) with UL Card.
2. Indicate the type of internal or external fusing that is incorporated in the SPD and what impact the fusing has on the performance of the device with respect to surge capacity and clamping levels.

E. Manufacturer must provide independent testing on repetitive capability and maximum surge current rating of service entrance suppressor units. This shall be performed at a nationally recognized lab not affiliated with the manufacturer.

1. Single pulse surge current capacity: single pulse surge current tested in a mode at rated surge currents. Single pulse surge current capacities of 200,000 A or less per mode are established by single pulse testing in a mode.
2. Single pulse surge current capacity test: an initial UL 1449 defined as 1.2 x 50µs, 6000V open circuit voltage waveform and an 8 x 20µs, 500A and 3kA short circuit current waveform is applied to benchmark the unit's suppression voltage.
3. A single pulse surge of maximum rated surge current (for units rated over 200,000A per mode, components or sub-assemblies are tested) magnitude with an approximated 8 x 20µs waveform is then applied. To complete the test, another UL 1449 surge shall be applied to verify the unit's survival. Survival is achieved if the suppression voltage measured from the two UL1449 surges does not vary by more than 10%.

F. Minimum Repetitive Surge Current Capacity.

1. Service entrance suppressor units should be tested repetitively to verify repetitive capacity.
2. Minimum Repetitive Surge Current Capacity Test:

a. An initial UL 1449 surge defined as 1.2 x 50µs, 6000V open circuit voltage waveform and an 8 x 20µs, 500A and 3kA short circuit current waveform is applied to benchmark the unit's suppression voltage.
b. A repetitive number of ANSI/IEEE C62.41.2-2002 (Category C3) surges defined as a 1.2 x 50µs 10kV or 20kV open circuit voltage waveform and an 8 x 20µs 10,000A short circuit current waveform are then applied at one minute intervals.
c. To complete the test, another UL 1449 surge shall be applied to verify the unit's survival.

3. Survival is achieved if the suppression voltage measured from the two UL 1449 surges does not vary by more than 10%.
4. Proof of such testing shall be the test log generated by the surge generator.

G. Short Circuit Fuse Testing.

1. Each design configuration shall be short circuit tested in accordance with the type of fusing utilized in the suppression path.
2. Short Circuit Fuse Test:

a. Testing shall include application of a sustained overvoltage that causes the unit to enter a bolted fault condition.
b. This bolted fault condition shall occur with the full rated AIC current of the fuse available.

3. The fuse shall fail in a safe manner with no physical or structural damage to the unit and any failure shall be self-contained within the unit.

H. Surge Current Fuse Testing.

1. Each design configuration shall be surge tested with fusing in series to verify that a transient of maximum surge current capacity magnitude is fully suppressed without fuse failure, operation or degradation.

I. Service Entrance SPD must be subjected to a series of waveforms as described in IEEE C62.41.2-2002. Clamping voltage measurements were taken throughout the tests to evaluate any deviations in performance as a result of the surges. Injected surges included the 1.2/50µs, 8/20µs waveforms at levels of 6kV/500A for bench marking, and high current 10/1000µs surges at 1.5, 3.1, 3.6 and 6.2 kA levels.

1.5 STANDARDS

A. UL 1449 3rd Edition. Underwriters laboratories safety standard for Surge Protection Devices.

B. NEC Article 285. National electrical code 2008 rev.

C. NFPA 780. STANDARD FOR THE INSTALLATION OF LIGHTNING PROTECTION SYSTEMS.

D. IEEE (Institute of Electrical and Electronic Engineering Inc.) C62.41.1 and C62.41.2 – 2002 rev.
IEEE C62.45 – 2002 rev
IEEE Std. 1100 "The Emerald Book" Section 8.4.2.5

E. CBEMA (ITIC) and IEC - (Computer Business Equipment Manufacturers Association or Information Technology Industry Council and International Electrotechnical Commission define clamping voltage tolerance guidelines for sensitive equipment)

F. All manufacturers must comply with above listed standards and any additions current revisions of industry standards. All products that do not comply with current industry standards will not be accepted.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain all suppression devices and accessories through one source from a single manufacturer.

1.7 PROJECT CONDITIONS

A. Placing into Service: Do not energize or connect service entrance equipment, panelboards, control terminals, or data terminals to their sources until the surge protective devices are installed and connected.

B. Each protection device shall have a capacitive filtering system connected in each Line-to-Neutral (L□N)(Wye) mode or Line to Line (L□L)(Wye or Delta) mode to provide EMI/RFI noise attenuation.

C. Protection modes: The SPD shall have 10 Dedicated Modes of Protection including Direct Line to Line. Provide (3) three Line to Neutral (L□N), (3) three Line-to-Ground (L□G), (3) three Line-to-Line (L□L) and (1) one Neutral-to-Ground (N□G) protection.

D. Service Conditions: Rate surge protective devices for continuous operation under the following conditions, unless otherwise indicated:

1. Maximum Continuous Operating Voltage (MCOV): Should be tested to 115% per UL 1449 3rd.
2. Operating Temperature: 0 to 50 deg F.
3. Humidity: 0 to 95 percent, noncondensing.
4. Altitude: Less than 12,000 feet above sea level.

1.8 COORDINATION

A. Coordinate location of field-mounted surge suppressors to allow adequate clearances for maintenance.

B. All devices must be installed on the load side of the facility after the first overcurrent protection or disconnect.

C. Products shall be installed external to service, distribution, and branch panel equipment. All SPDs must have the same or greater AIC, Interrupting, or Fault rating of the equipment the SPD is protecting.

D. Coordinate surge protective devices with Division 16 Section "Electrical Power Monitoring and Control."

1.9 WARRANTY

A. General Warranty: Special warranties specified in this article shall not deprive owner of other rights owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by contractor under requirements of the Contract Documents.

B. Manufacturer shall provide a product warranty for a period of not less than twenty-five (25) years from date of installation. Warranty shall cover unlimited replacement of SPD or modules during the warranty period. Those firms responding to this specification shall provide proof that they have been regularly engaged in the design, manufacturing and testing of SPD for not less than thirty (30) years.

PART 2 - PRODUCTS

2.1 SERVICE ENTRANCE SUPPRESSORS

A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Surge Suppression, Inc
2. LEA International Inc
3. Current Technology
4. Liebert
5. Advanced Protection Technologies

B. SPD shall be a multi-stage parallel protector. Please see one-line diagram and panelboard schedule to confirm voltages. SPD's minimum surge current capacity shall be **300kA** per phase (L-N plus L-G) and **100kA** per mode (L-N, L-G, L-L and N-G).

C. SPD shall contain a technology that utilizes component-level and short circuit current fused metal oxide varistors (MOV) per mode.

D. SPD shall be labeled as minimum with Type 2 (verifiable at UL.com). Every component of every mode, including N-G, shall be protected by internal thermal protection. SPDs relying upon external or supplementary installed safety overcurrent protection do not meet the intent of this specification.

E. All primary transient paths shall utilize copper wire, aluminum bus bar and lugs of equivalent capacity to provide equal impedance interconnection between phases. No plug-in module or components shall be used in surge carrying paths.

F. SPD shall be non-modular design.

G. SPD shall provide the following monitoring features: dry contacts, digital surge counter and audible alarm with alarm disable switch.

H. Equipment shall utilize a NEMA 12 enclosure.

I. If no circuit breaker is available add internal disconnect switch.

2.2 DISTRIBUTION PANEL SUPPRESSORS

A. Available Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Surge Suppression, Inc
2. LEA International Inc
3. Current Technology
4. Liebert
5. Advanced Protection Technologies

B. SPD shall be a multi-stage parallel protector. Please see one-line diagram and panelboard schedule to confirm voltages. SPD's minimum surge current capacity shall be **180kA** per phase (L-N plus L-G) and **60kA** per mode (L-N, L-G, L-L and N-G).

C. SPD shall meet all specification requirements in section 2.1 (C through E) and as follows:

D. SPD shall be non-modular design.

E. SPD shall provide the following monitoring features: dry contacts, surge counter and audible alarm with alarm disable switch.

F. SPD shall utilize a NEMA 12 enclosure.

G. If no circuit breaker is available add internal disconnect switch.

2.3 PANELBOARD SUPPRESSORS

A. Acceptable Manufacturers:

1. Surge Suppression, Inc
2. LEA International Inc
3. Current Technology
4. Liebert
5. Advanced Protection Technologies

B. SPD shall be a multi-stage non-parallel protector. Please see one-line diagram and panelboard schedule to confirm voltages. SPD's minimum surge current capacity shall be **120kA** per phase (L-N plus L-G) and **40kA** per mode (L-N, L-G, L-L and N-G).

C. SPD shall meet all specification requirements in section 2.1 (C through E) and as follows:

D. SPD shall be non-modular design.

E. SPD shall provide the following monitoring features: dry contacts and audible alarm.

F. SPD shall utilize a NEMA 1 enclosure or better.

G. If no circuit breaker is available add internal disconnect switch.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTIVE DEVICES

A. The specified unit shall be installed external to switchboard, distribution and panelboard as stand alone. Internal products will not be accepted.

B. The specified service entrance/switchboard/switchgear system shall be installed with the shortest lead length possible from the power conductor(s) it is protecting, must have a grounding of 25 Ohms (NEC Article 250.56) or less and shall avoid any unnecessary or sharp bends. Circuit breaker size is to be matched to SPD manufacturer wire size. Minimum circuit breaker size is 30A for connection means. See manufacturer's installation manual.

C. The specified distribution system shall be installed with the shortest lead length possible from the power conductor(s) it is protecting, must have a grounding of 25 Ohms (NEC Article 250.56) or less and shall avoid any unnecessary or sharp bends. Circuit breaker size is to be matched to SPD manufacturer wire size. Minimum circuit breaker size is 30A for connection means. See manufacturer's installation manual.

D. The specified branch panelboard system shall be installed with the shortest lead length possible from the power conductor(s) it is protecting, must have a grounding of 25 Ohms (NEC Article 250.56) or less and shall avoid any unnecessary or sharp bends. Circuit breaker size is to be matched to SPD manufacturer wire size. Minimum circuit breaker size is 30A for connection means. See manufacturer's installation manual.

3.2 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Testing: Contractor shall perform the following field quality-control testing:

B. Testing: Perform the following field quality-control testing:
1. After installing surge protective devices, but before electrical circuitry has been energized verify that the unit voltage and connecting equipment voltage is same.
2. Verify per NEC 285.6 that the SPD AIC rating is equal or greater to connecting equipment.
3. Complete startup checks according to manufacturer's written instructions.
4. Perform visual and mechanical inspection of each unit to verify light functionality.

END OF SECTION 26 43 00

SECTION 26 51 19 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior solid-state luminaires that use LED technology.
2. Lighting fixture supports.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 260926 "Lighting Control Panelboards" for panelboards used for lighting control.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, power supply/driver and housing.

H. Delivered Lumen: Measured light output exiting luminaire after all lensing reflector housing, etc.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, arranged by designation.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Factory drawings for each variation of recessed and suspended linear lighting systems including lengths that are integral to continuous run with emergency functions in them. Submit factory drawing indicating which room each run is intended for.
3. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Include diagrams for power, signal, and control wiring.

C. Alternate Manufacturers:

1. Provide one luminaire for each alternate manufacturer of product not listed in light fixture schedule. Sample luminaire shall be the specified color temperature, lumen output, correct size (i.e. 2x2 or 2x4), plug and cord installed on luminaire. Paint chip samples for non-standard colors shall be provided to Architect in size and quantity as required by Architect. Provision of sample does not imply approval of luminaire. All samples must be delivered (assembled and in working order) for inspection 15 working days prior to bid with 5 working days review period allocated to design team. Each sample shall have factory label with date of manufacturing and shall have been fabricated within 6 months of bid date.
2. Where material or equipment is identified by proprietary name, model number and/or manufacturer, furnish named item, or its equal of manufacturer indicated in this specification and as on Light Fixture Schedule. Alternate Manufacturers (other than first named or indicated as the basis of design) shall be equal or better in quality and performance and must be suitable for available space, required arrangement, and application. Submit all data necessary to determine suitability of

alternate manufacturers for review.

3. The suitability of named item only has been verified. Where more than one Manufacturer is named, only the first named Manufacturer has been verified as suitable. Manufacturers and items

other than first named shall be equal or better in quality and performance to that of specified items, and must be suitable for available space, required arrangement and application.

4. For each alternate manufacturer proposed by the Contractor, the Contractor shall clearly identify all differences (i.e., paragraph-by-paragraph, performance differences, physical differences, etc.) from the specified item, changes in Contract cost, benefits to the Owner and a brief description why the substitution is being proposed.

D. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

C. Product Certificates: For each type of luminaire.

1.6 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.7 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

1.8 ADDITIONAL MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Drivers: Provide 1 additional driver for every 25 luminaires of each type and rating installed. Furnish at least one of each type. Label packaging with Fixture Type (refer to LFS) for future reference by the maintenance department.
2. Lamps: Provide 1 additional led board (or module) for every 25 luminaires of each type and rating installed. Furnish at least one of each type. Label packaging with Fixture Type (refer to LFS) for future reference by the maintenance department.
3. Type ‘MV’ light fixture: Provide an additional 20 light fixtures to be applied as required in mechanical and other such spaces to achieve uniform illumination while adapting to other trade locations. Provide stainless steel fixed hanging loop. Unused light fixtures shall be turned over to Ownership.
4. Type ‘M’ light fixture: Provide an additional 10 light fixtures to be applied as required in mechanical and other such spaces to achieve uniform illumination while adapting to other trade locations. Provide stainless steel fixed hanging loop. Unused light fixtures shall be turned over to Ownership.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. Recessed Fixtures: Comply with NEMA LE 4.

E. CRI minimum of 90. CCT of 3500 Kelvin. unless otherwise noted on light fixture schedule.

F. Rated lamp life of 50,000 hours minimum at L70.

G. Dimmable from 100 percent to 10 percent of maximum light output minimum, flicker free and no cut outs (unless otherwise specifically noted in light fixture schedule for lower dimming range). All dimming controls shall be coordinated and confirmed with each light fixture manufacturer dimming driver prior to rough-in.

H. Internal driver. Bottom and/or room accessible when located in hard ceilings. No remote drivers unless specifically called for in light fixture schedule. All remote driver locations shall be submitted to architect for review and final approval prior to rough-in. Verify all remote driver distances from luminaire with manufacturer recommendations and adjust wire size as required for normal operation.
   1. Refer to remote driver details for additional requirements, mounting and arrangement of.

I. Nominal Operating Voltage: 120 V ac through 277 V ac (universal voltage) 12 V dc 24 V dc.

J. Housings:

   1. Extruded-aluminum housing and heat sink.
   2. Anodized powder-coat painted finishes. Finish per Architect.
   3. <u>All parts painted after fabrication</u> (room side and ceiling side, entire fixture assembly).

K. Refer to <u>all</u> Light Fixture Schedule General Notes.

2.3 ANIDOLIC OPTIC STYLE LUMINAIRES [RECESSED AND PENDANT VARIATIONS]

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Fluxwerx.
   2. All other alternative manufacturers shall comply with specification section 265119-1.3.

2.4 RECESSED TROFFERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Mercury Lighting.
   2. Finelite.
   3. Metalumen.
   4. Focal Point.
   5. Or approved equals. Refer to 265119-1.3-C.

B. Minimum and/or Maximum lumens shall be per light fixture schedule.

C. With integral mounting provisions.

D. Bottom/Room side access.

E. 0 – 10v. dimmable with isolated lead wires.

F. <u>All parts and pieces painted after fabrication</u> (room side and ceiling side, entire fixture assembly).

G. Spring loaded cam latch style for doors.

H. Flat Panel Style luminaires:
   1. Shall be edge-lit style.
   2. Back-lit style not allowed.

I. Volumetric style luminaires:

   1. Shall have their associated lens(es) extend from edge of housing to edge of housing with no gaps, visible hardware, visible sockets or led boards.

2. When specified as metal in lieu of luminous, side reflector(s) shall be smooth (no ribs, linear angles or prisms/beam modifiers, etc.) and flush to luminaire housing with no visible shadowing or gaps.

2.5 DOWNLIGHT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alphabet Lighting.
2. Ammerlux Lighting.
3. Kurt Versen
4. Edison Price Lighting.
5. Spectrum Lighting.
6. Or approved equals. Refer to 265119-1.3-C.

B. Minimum lumens shall be per light fixture schedule. Minimum allowable efficacy of 68 lumens per watt.

C. Universal mounting bracket.

D. Integral junction box with conduit fittings.

E. 0 – 10v. dimmable with isolated lead wires.

F. Aluminum heat sink.

G. Self-flanged.

H. Gloves or other protective items shall be used when interacting with the reflector system. No finger prints, dirt, or oils shall be visible. Any indication of these shall require replacement of reflector system at no cost to Manufacturer or Owner.

2.6 RECESSED LINEAR

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mercury Lighting.
2. Metalumen.
3. Finelite.
4. Focal Point.
5. Or approved equals. Refer to 265119-1.3-C.

B. Minimum lumens per lighting fixture schedule.

C. Integral junction box with conduit fittings.

D. Integral 0–10v. dimming driver with isolated lead wires.

E. Flush, snap in retention style Lensed (type as per light fixture schedule).

F. Refer to plans for housing lengths required. Continuous runs up to 8 ft. long shall be provided with one lens. Lengths over 8 ft. long up to 16 ft. long shall be provided with two lenses. Where two lenses meet, there will be no gap or light leak. Lensing at end of run shall not have more than 1/32 of an inch gap. Any indication of light leaks or exceeding indicated gap length at end of luminaire shall require replacement of lensing at no cost to Owner. 4ft long lenses for Wall Wash style luminaires only will be acceptable.

G. For all recessed linear runs located in lay-in grid ceilings, luminaire shall extend from t-bar to t-bar with no end plates, filler sections, etc. submit factory drawings for verification.

H. Mounting hardware for each recessed linear luminaire run shall be coordinated by Contractor with **all** other trades prior to ordering. Provide clearly defined submittal drawings indicating each location and associated hardware being provide at shop drawing level.

I. Extruded aluminum housing.

J. Refer to light fixture schedule General Notes.

K. All lensing shall be removed and cleaned per manufacturer recommendations after commissioning of lighting system for every single luminaire on project. Refer to section 265119-3.2.D.

2.7 STRIP LIGHT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Visioneering.
2. Mercury Lighting.
3. Columbia Lighting.
4. Or approved equals. Refer to 265119-1.3-C.

B. Minimum lumens shall be per light fixture schedule.

C. Integral junction box with conduit fittings.

D. Aluminum housing with no plastic end caps. Metal end caps only.

E. Integral 0-10v. dimming driver with isolated lead wires.

F. <u>All parts and pieces painted after fabrication</u> (room side and ceiling side, entire fixture assembly).

2.8 SUSPENDED, LINEAR

A. Manufacturers: Subject to compliance with requirements provide products by one of the following manufacturers:
1. Finelite.
2. Metalumen.
3. Mercury Lighting.
4. Focal Point.
5. Or approved equals. Refer to 265119-1.3-C.

B. Minimum lumens shall be per lighting fixture schedule.

C. Clear dust cover (where applicable).

D. Integral 0-10v. dimming driver with isolated lead wires.

E. Mounting hardware submittals including power feed details, aircraft cable suspension details and suspension points.

F. Extruded aluminum housings.

G. Refer to plans for housing lengths required. Continuous runs up to 8 ft. long shall be provided with one lens. Lengths over 8 ft. long up to 16 ft. long shall be provided with two lenses. Where two lenses meet, there will be no gap or light leak. Lensing at end of run shall not have more than 1/32 of an inch gap. Any indication of light leaks or exceeding indicated gap length at end of luminaire shall require replacement of lensing at no cost to owner. 4ft long lenses for Wall Wash style luminaires only will be acceptable.

H. Flush, snap in retention style Lensed (type as per light fixture schedule).

I. Refer to light fixture schedule General Notes.

J. For all adjustable suspension applications, do not trim support cables until final mounting height has been field verified with Architect.

K. All lensing, direct and/or indirect shall be removed and cleaned per manufacturer recommendations after commissioning of lighting system for every single luminaire on project. Refer to section 265119-3.2.D.

2.9 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers, and Globes:

1. Acrylic: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

2.10 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.11 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports: Sized and rated for luminaire weight.

E. Flush-Mounted Luminaire Support: Secured to outlet box.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls Attached to a minimum 20 gauge backing plate attached to wall structural members Attached using through bolts and backing plates on either side of wall.
2. Do not attach luminaires directly to gypsum board.

G. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with two 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 120 inches (6 m) in length.
2. Ceiling mount with pendant mount four-point pendant mount with 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 120 inches (6 m) in length.
3. Ceiling mount with hook mount.

H. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire using approved fasteners in a minimum of four locations, spaced near corners of luminaire.

J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

K. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

L. Emergency light fixtures shall be labeled “EM” and be visible from floor. Provide Phenolic labeling on ceiling grid at fixture with black letting and white background (verify location of name plate for fixtures that are wall mounted). Verify all labeling types, styles, lettering with Owner representative.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to generator power and retransfer too normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

D. At substantial completion of project/each phase, For all Linear runs (recessed, surface or suspended); remove all lensing (direct and/or indirect) and clean lensing **as directed by manufacturer** removing all dust, debris, cable clippings, lose or exposed wiring, screws, etc. Re-install all lensing and verify compliance with Light Fixture Schedule General Noting.

END OF SECTION 26 51 19

SECTION 26 56 13 - LIGHTING POLES AND STANDARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Poles and accessories for support of luminaires.
2. Luminaire-lowering devices.

1.3 DEFINITIONS

A. EPA: Effective projected area.

B. Luminaire: Complete lighting fixture.

C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.

D. Standard: See "Pole."

1.4 ACTION SUBMITTALS

A. Product Data: For each pole, accessory, and luminaire-supporting and -lowering device.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of poles and pole accessories.
4. Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the state of installation.
5. Anchor bolt templates keyed to specific poles and certified by manufacturer.
6. Method and procedure of pole installation. Include manufacturer's written installations.

1.5 ALTERNATE MANUFACTURERS:

A. Refer to specification section 26 56 19 – 1.3 – C.

1.6 INFORMATIONAL SUBMITTALS

A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements according to AASHTO LTS-6-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations signed and sealed by a professional engineer.

B. Seismic Qualifications for entire pole assembly.

C. Material test reports.

D. Field quality-control reports.

E. Soil test reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and maintenance data for luminaire maintenance and pole-mounted accessories.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of pole(s) that fail in materials or

workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design pole foundation and pole power system.

B. Seismic Performance: Foundation and pole shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
2. Component Importance Factor: 1.5.

C. Structural Characteristics: Comply with AASHTO LTS-6-M.

D. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.

E. Live Load: Single load of 500 lbf (2200 N) distributed according to AASHTO LTS-6-M.

F. Ice Load: Load of 3 lbf/sq. ft. (145 Pa), applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.

G. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.

1. Basic wind speed for calculating wind load for poles 50 feet (15 m) high or less is 100 mph (45 m/s).

a. Wind Importance Factor: 1.0.
b. Minimum Design Life: 25 years.
c. Velocity Conversion Factor: 1.0.

H. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.

I. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

2.2 STEEL POLES

a. Not allowed.

2.3 CAST ALUMINUM POLES

A. Sole sourced from same manufacturer as attached luminaire.

B. Poles: 1 piece, cast aluminum alloy ANSI 356 per ASTM B26-95, with access handhole in in pole base wall.

1. Shape: Decorative cast.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
3. Provide internal barrier separation or internal raceway for security system cabling where applicable.

C. Mount for Luminaires: Tennon.

1. Tennon fitting cast into pole

D. Grounding and Bonding Lugs: Bolted 1/2-inch (13-mm) threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

E. Fasteners: Stainless steel or Galvanized steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.

1. Materials: Compatible with poles and standards as well as to substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.

2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

F. Handhole: Oval or Rectangular shaped, with minimum clear opening of 2-1/2 by 5 inches (65 by 130 mm), with cover secured by stainless-steel captive screws.

G. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I clear coating of 0.018 mm or thicker), complying with AAMA 611.
4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

H. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Powder coat shall comply with AAMA 2604.
   a. Electrostatic applied powder coating; single application with a minimum 2.5- to 3.5-mils dry film thickness; cured according to manufacturer's instructions. Coat interior and exterior of pole for equal corrosion protection.
   b. Color: As selected by Architect from manufacturer's full range.

2.4 POLE ACCESSORIES

A. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.

B. Transformer-Type Bases: Not allowed.

2.5 MOUNTING HARDWARE

A. Anchor Bolts: Manufactured to ASTM F 1554, Grade 55, with a minimum yield strength of 55,000 psi (380,000 kPa).

1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
2. Bent Headed rods <Insert inches (mm)> in diameter by <Insert inches (mm)> in length.
3. Threading: Uniform National Coarse Uniform National 8, Class 2A.

B. Nuts: ASTM A 563, Grade A, Heavy-Hex

1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
2. Four nuts provided per anchor bolt , shipped with nuts pre-assembled to the anchor bolts.

C. Washers: ASTM F 436, Type 1.

1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
2. Two washers provided per anchor bolt.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 POLE FOUNDATION

A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123 M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete." Concrete finish shall be a smooth finish with no spiral casting markings.

B. Pre-Cast Foundations: Factory fabricated, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete." Concrete finish shall be a smooth finish with no spiral casting markings.

C. Power-Installed Screw Foundations: Not Allowed.

D. Direct-Buried Foundations: Not Allowed.

E. Direct-Buried Poles with Concrete Backfill: Not Allowed.

F. Anchor Bolts: Install plumb using manufacturer-supplied steel plywood template, uniformly spaced.

3.2 POLE INSTALLATION

A. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 033000 "Cast-in-Place Concrete."

B. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.

C. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch- (150-mm-) wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch (25 mm) below top of concrete slab.

D. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.3 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum using insulating fittings or treatment.

B. Steel Conduits: Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

3.4 GROUNDING

A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

B. Ground Nonmetallic Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole.
2. Install grounding conductor and conductor protector.
3. Ground metallic components of pole accessories and foundation.

END OF SECTION 26 56 13

SECTION 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Grounding conductors.
2. Grounding connectors.
3. Grounding busbars.
4. Grounding rods.
5. Grounding labeling.

1.3 DEFINITIONS

A. BCT: Bonding conductor for telecommunications.

B. EMT: Electrical metallic tubing.

C. TGB: Telecommunications grounding busbar.

D. TMGB: Telecommunications main grounding busbar.

1.4 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:

1. Ground rods.
2. Ground and roof rings.
3. BCT, TMGB, TGBs, and routing of their bonding conductors.

B. Qualification Data: For Installer, installation supervisor, and field inspector.

C. Qualification Data: For testing agency and testing agency's field supervisor.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Installation Supervision: Installation shall be under the direct supervision of ITS Technician who shall be present at all times when Work of this Section is performed at Project site.

2. Field Inspector: Currently registered by BICSI as an ITS Installer 2 to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 SYSTEM COMPONENTS

A. Comply with J-STD-607-A.

2.2 CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Panduit Corp.
2. TE Connetivity Ltd.
3. Harger Lightning & Grounding.

B. Comply with UL 486A-486B.

C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.

1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
2. Cable Tray Equipment Grounding Wire: No. 8 No. 6 AWG.

D. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmils (14.2 sq. mm), 14 strands of No. 17 AWG conductor, and 1/4 inch (6.3 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.3 CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Panduit Corp.
2. TE Connetivity Ltd.
3. Harger Lightning & Grounding.

Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.

B. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.

1. Electroplated tinned copper, C and H shaped.

C. Busbar Connectors: Cast silicon bronze, solderless exothermic-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch (15.8- or 25.4-mm) centers for a two-bolt connection to the busbar.

D. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING BUSBARS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Panduit Corp.
2. Harger Lightning & Grounding.
3. Chatsworth Products, Inc.

B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with J-STD-607-A.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide a 4-inch (100-mm) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

C. TGB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches (6.3 by 50 mm) in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with J-STD-607-A.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch (50-mm) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

D. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with J-STD-607-A. Predrilling shall be with holes for use with lugs specified in this Section.

1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
2. Rack-Mounted Horizontal Busbar: Designed for mounting in 23-inch (584-mm) equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
3. Rack-Mounted Vertical Busbar 36 inches (914 mm) long, with stainless-steel or copper-plated hardware for attachment to the rack.

2.5 GROUND RODS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Panduit Corp.
2. HellermannTyton
3. Brother International Corp.

B. Ground Rods: Copper-clad - steel 3/4 inch by 10 feet (19 mm by 3 m) 5/8 by 96 inches (16 by 2400 mm) in diameter.

2.6 LABELING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Panduit Corp.
2. HellermannTyton
3. Brother International Corp.

B. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.

B. Inspect the test results of the ac grounding system measured at the point of BCT connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.

B. Comply with NECA 1.

C. Comply with J-STD-607-A.

3.3 APPLICATION

A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 4 AWG.

B. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

C. Conductor Support:

1. Secure grounding and bonding conductors at intervals of not less than 36 inches (900 mm).

D. Grounding and Bonding Conductors:

1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
2. Install without splices.
3. Support at not more than 36-inch (900-mm) intervals.
4. Install grounding and bonding conductors in 3/4-inch (21-mm) PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.

    a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.4 GROUNDING ELECTRODE SYSTEM

A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 4/0 AWG.

3.5 GROUNDING BUSBARS

A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 12 inches (300 mm) above finished floor unless otherwise indicated.

B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.6 CONNECTIONS

A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.

B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.

C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:

1. Use crimping tool and the die specific to the connector.
2. Pretwist the conductor.
3. Apply an antioxidant compound to all bolted and compression connections.

D. Primary Protector: Bond to the TMGB with insulated bonding conductor.

E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot (1 sq. mm/linear meter) of conductor length, up to a maximum size of No. 3/0 AWG 168 kcmils (85 sq. mm) unless otherwise indicated.

F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install top-mounted vertically mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.

G. Security camera surge suppressors: Provide grounding to security camera surge suppressors (provided by others). Coordinate all connections with Next Gen Security.

H. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.

I. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.

J. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA/EIA-568-B.1 and TIA/EIA-568-B.2 when grounding screened, balanced, twisted-pair cables.

K. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

3.7 IDENTIFICATION

A. Labels shall be preprinted or computer-printed type.

1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.

    a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.

3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.

    a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1 A.

C. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.

D. Grounding system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 27 05 26

SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Optical-fiber-cable pathways and fittings.
4. Metal wireways and auxiliary gutters.
5. Nonmetallic wireways and auxiliary gutters.
6. Metallic surface pathways.
7. Nonmetallic surface pathways.
8. Hooks.
9. Boxes, enclosures, and cabinets.
10. Polymer-concrete handholes and boxes for exterior underground cabling.

1.3 ACTION SUBMITTALS

A. Product data for each type of product.

B. Shop Drawings: For enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Pathway routing plans, drawn to scale and coordinated with each other, using input from installers of items involved.

B. Qualification Data: For professional engineer.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems; a part of Atkore International.
2. Allied Tube & Conduit; a part of Atkore International.
3. Alpha Wire.
4. Anamet Electrical, Inc.
5. Electri-Flex Company.
6. O-Z/Gedney; a brand of Emerson Industrial Automation.
7. Picoma Industries, Inc.
8. Plasti-Bond.

9. Republic Conduit.
10. Southwire Company.
11. Thomas & Betts Corporation; A Member of the ABB Group.
12. Western Tube and Conduit Corporation.

C. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
2. Comply with TIA-569-C.

D. GRC: Comply with ANSI C80.1 and UL 6.

E. PVC-Coated Steel Conduit: PVC-coated GRC.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

F. EMT: Comply with ANSI C80.3 and UL 797.

G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
2. Fittings for EMT:

a. Material: Steel.
b. Type: Compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

H. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

A. Description: Comply with UL 2024; flexible-type pathway with a circular cross section, approved for plenum installation unless otherwise indicated.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire.
2. Carlon; a brand of Thomas & Betts Corporation.
3. Dura-Line.
4. Endot Industries Inc.

2.3 SURFACE METAL PATHWAYS

A. Description: Galvanized steel with snap-on covers, complying with UL 5.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Wiremold/Legrand
2. MonoSystems, Inc.
3. Niedax Inc.
4. Panduit Corp.

C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with TIA-569-C.

2.4 HOOKS

A. Description: Prefabricated sheet metal cable supports for telecommunications cable.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. MonoSystems, Inc.
2. Panduit Corp.

C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with TIA-569-C.

E. Galvanized steel.

F. J shape.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Minimum Pathway Size: 3/4-inch (21-mm) trade size for copper and aluminum cables, and 1 inch (25 mm) for optical-fiber cables.

B. Pathway Fittings: Compatible with pathways and suitable for use and location.

C. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

D. Install surface pathways only where indicated on Drawings.

3.2 INSTALLATION

A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-C.
4. NECA 101
5. NECA 102.
6. NECA 105.
7. NECA 111.

B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

D. Comply with requirements in Section 270528.29 "Hangers and Supports for Communications Systems" for hangers and supports.

E. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.

F. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

G. Complete pathway installation before starting conductor installation.

H. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.

I. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

J. Support conduit within 12 inches (300 mm) of enclosures to which attached.

K. Pathways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot (3-m) intervals.
2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
3. Arrange pathways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from nonmetallic conduit and fittings to GRC and fittings before rising above floor.

L. Stub-ups to Above Recessed Ceilings:

1. Use EMT for pathways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

N. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.

P. Cut conduit perpendicular to the length. For conduits of 2-inch (50-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

Q. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

R. Surface Pathways:

1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
2. Install surface pathway with a minimum 2-inch (50-mm) radius control at bend points.
3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

S. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch (21-mm) Trade Size and Smaller: Install pathways in maximum lengths of 50 feet (15 m).
2. 1-Inch (25-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).
3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

T. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway-sealing fittings according to NFPA 70.

U. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

W. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT that is located where environmental temperature change may exceed 100 deg F (55 deg C), and that has straight-run length that exceeds 100 feet (30 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
   d. Attics: 135 deg F (75 deg C) temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

X. Hooks:

1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
3. Hook spacing shall allow no more than 6 inches (150 mm) of slack. The lowest point of the cables shall be no less than 6 inches (150 mm) adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
4. Space hooks no more than 5 feet (1.5 m) o.c.

5. Provide a hook at each change in direction.

Y. Mount boxes at heights indicated on Drawings. Install boxes with height measured to top of box unless otherwise indicated.

Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

AA. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

CC. Set metal floor boxes level and flush with finished floor surface.

DD. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Install backfill.
2. After installing conduit, backfill and compact.
3. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete around conduit for a minimum of 12 inches (300 mm) on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

4. Underground Warning Tape: Comply with requirements in Section 270553 "Identification for Communications Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Field cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 27 05 28

SECTION 27 05 44 - SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:

1. Material: Galvanized-steel sheet.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by the following provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Advance Products & Systems, Inc.
    b. CALPICO, Inc.
    c. Metraflex Company (The).
    d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. HOLDRITE.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
   a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
   b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 3 inches (76.2 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 27 05 44

SECTION 27 11 00 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Telecommunications mounting elements.
2. Backboards.
3. Telecommunications equipment racks and cabinets.
4. Telecommunications service entrance pathways.
5. Uninterruptible Power Supply
6. Grounding.

B. Related Sections:

1. Division 27 Section "Data, Voice & Video" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

C. LAN: Local area network.

D. RCDD: Registered Communications Distribution Designer.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
3. Field Inspector: Currently registered by BICSI as Commercial Installer, Level 2 to perform the on-site inspection.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

D. Grounding: Comply with ANSI-J-STD-607-A.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.7 COORDINATION

A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings and distribute them to other participants.
3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.

1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
2. Support brackets with cable tie slots for fastening cable ties to brackets.
3. Lacing bars, spools, J-hooks, and D-rings.
4. Straps and other devices.

C. Cable Trays:

1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Chatsworth
   b. Cooper B-Line, Inc.
   c. Cope - Tyco/Allied Tube & Conduit.
   d. GS Metals Corp.
   e. Hubbell

2. Cable Tray Materials: Metal, suitable for indoors and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch (0.012 mm) thick.
   a. Ladder Cable Trays: Nominally 18 inches (455 mm) wide, and a rung spacing of 12 inches (305 mm).

D. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."

1. Outlet boxes shall be no smaller than 4 inches (100 mm) wide, 4 inches (100 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Division 06 Section "Rough Carpentry."

B. Paint all backboards “BLACK”.

2.3 EQUIPMENT FRAMES

A. Description: Two-post racks with threaded rails designed for mounting telecommunications equipment. Width is compatible with EIA/ECIA 310-E, 19-inch (482.6-mm) equipment mounting with an opening of 17.72-inches (450-mm) between rails.

B. Basis-of-Design Product: Subject to compliance with requirements, provide CommScope, Inc.; RK3-45A or a comparable product by one of the following:

1. Hubbell Premise Wiring.
2. Chatsworth

C. General Requirements:

1. Frames: Modular units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Material: Aluminum.
3. Finish: Manufacturer's standard, baked-polyester powder coat.
4. Color: Black.

D. Floor-Mounted Racks:

1. Overall Height: 84-inches (2133.6-mm).

2. Overall Width: 20.4-inches (518.16-mm
3. Overall Depth: 15-inches (381-mm).
4. Upright Depth: 3-inches (76.2-mm)
5. Two-Post Load Rating: 1,000-lb (453.6-kg).
6. Number of Rack Units per Rack: 45

    a. Numbering: Every rack units, on interior of rack.

7. Threads: 12-24.
8. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
9. Base shall have a minimum of four mounting holes for permanent attachment to floor.
10. Top shall have provisions for attaching to cable tray or ceiling.
11. Self-leveling.

E. Cable Management:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.4 UNINTERRUPTIBLE POWER SUPPLY (MDF & IDF RACKS)

A. Provide one (1) UPS unit in each MDF & IDF data equipment rack, and any equipment rack not connected to the central UPS described below. The UPS system shall be line interactive design with a maximum transfer of 4 milliseconds. The UPS shall be a single conversion modular UPS system with SNMP management.

1. The UPS system shall provide a minimum of 2880 VA of output power with 120 Volt input. UPS shall connect to a NEMA L5-30 Receptacle.
2. The UPS system shall provide a minimum battery runtime of 60 minutes at full load.
3. The output waveform of UPS shall be true sine-wave.
4. The UPS system shall be provided with a minimum of six NEMA 5-15R output receptacles.
5. The system shall be covered by a two-year on-site warranty.
6. The front panel display shall indicate load level, battery charge level, and replacement battery indication.
7. The UPS system shall be rack-mounted in the bottom of each 19” equipment rack.
8. The UPS shall be APC Smart UPS Model SMTL3KRM2UCLNC, or approved equal.
9. Provide grounding per EIA/TIA 607 requirements.

B. Provide manufacturer field services and maintenance services for a period of 2 years on all UPS units from date of final acceptance of UPS system.

2.5 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Rack mounting.
3. Six 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
4. LED indicator lights for power and protection status.
5. LED indicator lights for reverse polarity and open outlet ground.
6. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
7. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
8. Cord connected with 15-foot (4.5-m) line cord.

9. Rocker-type on-off switch, illuminated when in on position.
10. Peak Single-Impulse Surge Current Rating: 13 kA per phase.
11. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all three modes shall be not more than 330 V.

2.6 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.

B. Telecommunications Main Bus Bar:

1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide (6 mm thick by 100 mm wide) with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart.
3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Comply with ANSI-J-STD-607-A.

2.7 LABELING

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

B. Install underground pathways complying with recommendations in TIA/EIA-569-A, "Entrance Facilities" Article.

C. Comply with NECA 1.

D. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

E. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.

F. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.2 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping." Comply with TIA/EIA-569-A, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

C. Provide Specified Technologies, Inc (STI) EZ Path Cable Pathway sleeves at all cable penetrations through walls in the telecommunications rooms (MDF and IDF rooms). Provide multiple Series 33 and Series 44 as needed to serve cabling being installed plus 100% spare capacity.

3.3 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
   1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.4 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Division 26 Section "Identification for Electrical Systems." Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

B. See Division 27 Section "Data, Voice & Video" for additional identification requirements. See Evaluations for discussion of TIA/EIA standard as it applies to this Section. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 3 level of administration including optional identification requirements of this standard.

C. Labels shall be preprinted or computer-printed type.

3.5 COORDINATION

A. All equipment and MDF/IDF room layouts and rack configuration layouts shall be coordinated and approved by Director of Technology at the Council Rock School District.

END OF SECTION 27 11 00

SECTION 27 13 23 - COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Backboards.
2. 850 nanometer laser-optimized 50/125 micrometer multimode optical fiber cable (OM3).
3. Optical fiber cable connecting hardware, patch panels, and cross-connects.
4. Cabling identification products.

1.3 OPTICAL FIBER BACKBONE CABLING DESCRIPTION

A. Optical fiber backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration drawings and printouts.
4. Wiring diagrams to show typical wiring schematics including the following:

    a. Cross-connects.
    b. Patch panels.
    c. Patch cords.

5. Cross-connects and patch panels.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For RCDD, Installer, , installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On USB media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

B. Maintenance data.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: Certified by BICSI.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

D. Telecommunications Pathways and Spaces: Comply with TIA-569-C.

E. Grounding: Comply with TIA-607-B.

1.9 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Section 061000 "Rough Carpentry" for plywood backing panels.

2.2 9/125 MICROMETER SINGLE-MODE, INDOOR-OUTDOOR OPTICAL FIBER CABLE (OS1)

Retain one of two "Description" paragraphs below. Typically, fiber counts up to 12 would be in a single loose tube, and fiber counts in multiples of 12 (24 and up) would be in stranded loose tubes. Confirm with manufacturer.

A. Description: Single mode, 9/125-micrometer, 24 fibers, stranded loose tube, armored optical fiber cable.

B. Standards:

1. Comply with TIA-492CAAA for detailed specifications.
2. Comply with TIA-568-C.3 for performance specifications.
3. Comply with ICEA S-104-696 for mechanical properties.

C. Armored cable shall be aluminum armored type.

D. Maximum Attenuation: 0.5 dB/km at 1310 nm; 0.5 dB/km at 1550 nm.

E. Jacket:

1. Jacket Color: Yellow.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

F. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

1. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
2. Plenum Rated, Nonconductive: Type OFNP in listed plenum communications raceway.
3. Plenum Rated, Nonconductive: Type OFNP, or Type OFNR in metallic conduit.
4. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262; Type OFNP in listed plenum communications raceway; or Type OFN, Type OFNG, Type OFNP, or Type OFNR in metallic conduit.
5. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
6. Riser Rated, Nonconductive: Type OFNP or Type OFNR in listed riser or plenum communications raceway.
7. Riser Rated, Nonconductive: Type OFNP, or Type OFNR in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
8. Plenum Rated, Armored (Conductive): Type OFCP, complying with NFPA 262.
9. Plenum Rated, Armored (Conductive): Type OFCP or Type OFNP in listed plenum communications raceway.
10. Plenum Rated, Armored (Conductive): Type OFCP, Type OFNP, Type OFCR, or Type OFNR in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
11. Riser Rated, Armored (Conductive): Type OFCR; complying with UL 1666.
12. Riser Rated, Armored (Conductive): Type OFCP, Type OFNP, or Type OFCR or Type OFNP in listed riser or plenum communications raceway.
13. Riser Rated, Armored (Conductive): Type OFCP, Type OFNP, Type OFCR, or Type OFNR in metallic conduit.

2.3 9/125 MICROMETER, SINGLE-MODE, INSIDE PLANT OPTICAL FIBER CABLE (OS1)

A. Description: Single mode, 9/125-micrometer, 24 fibers, tight buffered, optical fiber cable.

B. Standards:

1. Comply with TIA-492CAAA for detailed specifications.
2. Comply with TIA-568-C.3 for performance specifications.

3. Comply with ICEA S-83-596 for mechanical properties.

C. Conductive cable shall be aluminum armored type.

D. Maximum Attenuation: 1.0 dB/km at 1310 nm; 1.0 dB/km at 1550 nm.

E. Jacket:

1. Jacket Color: Yellow.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

F. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

1. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
2. Plenum Rated, Nonconductive: Type OFNP in listed plenum communications raceway.
3. Plenum Rated, Nonconductive: Type OFN, Type OFNG, Type OFNP, or Type OFNR in metallic conduit.
4. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262; Type OFNP in listed plenum communications raceway; or Type OFN, Type OFNG, Type OFNP, or Type OFNR in metallic conduit.
5. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
6. Riser Rated, Nonconductive: Type OFNP or Type OFNR in listed riser or plenum communications raceway.
7. Riser Rated, Nonconductive: Type OFN, Type OFNG, Type OFNP, or Type OFNR in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."

2.4 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Corning 95-050-41 w/ OR-615SCDSM6.
2. Belden AX104246 w/ AX100098.

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.

D. Cable Connecting Hardware:

1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA-604-2-B for Type ST connectors, TIA-604-3-B for Type SC connectors, TIA-604-10-B for Type LC connectors, TIA/EIA-604-12 for Type MT-RJ connectors, and TIA-604-5-D for Type MPO connectors. Comply with TIA-568-C.3.
2. Quick-connect, simplex and duplex, Type SC connectors. Insertion loss not more than 0.25 dB.

2.5 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Comply with TIA-607-B.

2.6 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.7 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test multimode optical fiber cables according to TIA-526-14-B and TIA-568-C.3.

C. Factory test pre-terminated optical fiber cable assemblies according to TIA-526-14-B and TIA-568-C.3.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

A. Comply with NECA 301.

B. General Requirements for Cabling:

1. Comply with TIA-568-C.1.
2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.

4. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) on “J” hooks or other suitable cable management devices and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Provide solid bottom cable trays in any exposed ceiling spaces in finished areas for cable routing. Paint cable tray to match surrounding finish. Refer to architectural reflected ceiling plans for final layout. Provide a layout plan during shop drawing phase for final coordination.
7. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
8. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
9. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
10. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
11. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
12. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. Optical Fiber Cable Installation:

1. Comply with TIA-568-C.3.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

D. Group connecting hardware for cables into separate logical fields.

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-C, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with TIA-607-B and NECA/BICSI-607.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Comply with requirements in Section 271500 "Communications Horizontal Cabling" for cable and asset management software.

D. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

F. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
4. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections with the assistance of a factory-authorized service representative.

C. Tests and Inspections:

1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Optical Fiber Cable Tests:

a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
b. Link End-to-End Attenuation Tests:

1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-B, Method B, One Reference Jumper.
2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than those calculated according to equation in TIA-568-C.1.

D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

E. Remove and replace cabling where test results indicate that it does not comply with specified requirements.

F. End-to-end cabling will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

END OF SECTION 27 13 23

SECTION 27 15 00 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. UTP cabling.
2. Multiuser telecommunications outlet assemblies.
3. Cable connecting hardware, patch panels, and cross-connects.
4. Telecommunications outlet/connectors.
5. Cabling system identification products.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
2. Wiring diagrams to show typical wiring schematics, including the following:

   a. Cross-connects.
   b. Patch panels.
   c. Patch cords.

3. Cross-connects and patch panels. Detail mounting assemblies and show elevations and physical relationship between the installed components.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.

1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Grounding: Comply with J-STD-607-A.

2.3 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Section 061000 "Rough Carpentry" for plywood backing panels.

2.4 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide General Cable GenSpeed 6000 or comparable product by one of the following:

1. ADC.
2. Belden Inc.
3. CommScope, Inc
4. Mohawk; a division of Belden Networking, Inc.
5. 3M Communication Markets Division.

C. Description: 100-ohm, four-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 6.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

   a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.

2.5 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide Panduit or comparable product by one of the following:

1. ADC.
2. Belden Inc.
3. CommScope, Inc
4. Mohawk; a division of Belden Networking, Inc.
5. 3M Communication Markets Division.

C. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

D. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

F. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
2. Provide with strain relief brackets
3. Provide with dust covers
4. 48-port angled

G. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

H. Patch Cords: Factory-made, four-pair cables in 60-inch (1524 mm) lengths, unless otherwise noted; terminated with eight-position modular plug at each end. Size and length to be determined by owner.

1. Patch cords shall have strain-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.

2. Patch cords shall have color-coded boots for circuit identification.
3. Thermoplastic jacket shall be white in color.
4. Confirm length of patch cord with school district IT department.
5. 2 patch cables for every one non-shielded network cable installed.
6. 2 shielded patch cables for every shielded network cable installed

2.6 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.

B. Workstation Outlets: Four-port-connector assemblies mounted in single faceplate.

1. Stainless Steel: Type 302. Coordinate color with Section 262726 "Wiring Devices."
2. For use with snap-in jacks accommodating any combination of UTP work area cords.

a. Flush mounting jacks, positioning the cord at a 45-degree angle.

3. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.7 GROUNDING

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with J-STD-607-A.

2.8 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Section 260553 "Identification for Electrical Systems."

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Install cables in pathways except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal pathways and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
2. Install lacing bars and distribution spools.
3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
12. Provide “J” hooks or other suitable cable management devices at intervals not to exceed 4’-0” on center.
13. Provide solid bottom cable trays in any exposed ceiling spaces in finished areas for cable routing. Paint cable tray to match surrounding finish. Refer to architectural reflected ceiling plans for final layout. Provide a layout plan during shop drawing phase for final coordination.
14. All exterior network data drops shall be shielded CAT6 cable runs properly grounded at the patch panel.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Group connecting hardware for cables into separate logical fields.

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-B, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified by school district IT department. All labeling requirements shall be coordinated and approved by the school district.

B. Where ceiling data drops are located, a blue adhesive dot shall be provided on ceiling grid to mark the data drop location. Provide a duplicate data cable label on grid adjacent to the blue dot identifying the cable that is above the ceiling.

C. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

D. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, [backbone pathways and cables,] [entrance pathways and cables,] terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

F. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in J-Hooks: Label each cable at intervals not exceeding 15 feet (4.5 m).
4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Visually inspect UTP jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually confirm Category 6 marking of outlets, cover plates, outlet/connectors, and patch panels.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments

(Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

5. UTP Performance Tests:

   a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:

      1) Wire map.
      2) Length (physical vs. electrical, and length requirements).
      3) Insertion loss.
      4) Near-end crosstalk (NEXT) loss.
      5) Power sum near-end crosstalk (PSNEXT) loss.
      6) Equal-level far-end crosstalk (ELFEXT).
      7) Power sum equal-level far-end crosstalk (PSELFEXT).
      8) Return loss.
      9) Propagation delay.
      10) Delay skew.

6. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.

   a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
   b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

B. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

C. End-to-end cabling will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

END OF SECTION 27 15 00

SECTION 27 40 00 - AUDIO-VISUAL SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Scope of Work: Provide a complete, fully integrated, turnkey Audio-Visual (AV) system for Board Room 108, Historic Classroom 104, Historic Classroom 106, and the central AV network equipment rack in IDF 102 as detailed herein.

B. Contractor Responsibilities: Supply all hardware procurement, custom software programming, installation cabling, infrastructure coordination, physical mounting, testing, multi-platform verification, commissioning, and client training.

C. The design provides a complete meeting and presentation system for Board Room 108 and two smaller conference/classroom spaces. Board Room 108 supports local presentations, hybrid meetings, streaming/recording, discussion microphones, wireless microphones, automatic camera tracking, room sound reinforcement, assisted listening, and overflow feeds to Rooms 104 and 106. The two smaller rooms can operate independently or display the live Board Room program.

D. The system uses AMX AV-over-IP video distribution and control, Biamp audio processing and Parlé conferencing video bars, Audio-Technica discussion microphones, Shure microphones, AVer cameras and tracking, and a managed Cisco AV network. The user experience is based on simple meeting modes so staff and volunteers do not need to operate individual components.

E. Local HDMI sources and the conferencing computer are encoded onto the AMX AV network. The system routes selected content to two 98-inch front displays, two 50-inch rear displays, the conferencing/streaming computer, and the overflow rooms. The displays can show the same image or different sources depending on the selected meeting mode.

1.3 CONFERENCING, STREAMING, AND CAMERAS

A. Three AVer CAM520 Pro3 PTZ cameras provide dais, podium, and audience views. The MT300N recalls camera presets and automatically switches views using microphone activity. Staff can select cameras and presets manually from the AMX touchpanel or an optional owner-furnished iPad.

B. An owner-furnished computer will be used to provide Teams, Zoom, Google Meet, streaming, and recording applications. It receives the selected camera feed from the MT300N and processed USB audio from the Biamp system. A selected presentation feed is provided through an AMX decoder and HDMI capture interface. The computer and HDMI capture hardware to be provided by the Owner.

1.4 MICROPHONES AND ROOM AUDIO

A. Twelve Audio-Technica discussion stations serve the dais and support controlled board-member participation. A Shure wireless gooseneck microphone serves the podium, and a wireless handheld microphone supports audience questions. Two Shure MXA920 ceiling arrays provide audience pickup for remote participants and camera tracking.

B. A Biamp TesiraFORTÉ processors manage microphone mixing, acoustic echo cancellation, presentation audio, far-end conferencing audio, recording/streaming mixes, overflow audio, and assisted listening. A four-channel Biamp amplifier powers eighteen ceiling loudspeakers arranged in four zones for even speech coverage.

1.5 CONTROL

A. The AMX control system coordinates display power, source routing, audio levels, microphones, cameras, overflow routing, and system startup/shutdown. Two 10-inch touchpanels provide local control, and an iPad application provides optional mobile control from the rear of the room. Typical functions include meeting mode, source selection, display routing, volume, microphone controls, camera mode/presets, overflow enable.

1.6 HISTORIC CLASSROOMS 104 AND 106

A. Each room includes one 86-inch display, two table, one wall presentation/BYOD inputs, a Biamp Parlé VBC 2800 conferencing video bar, and a simple AMX button controller. The VBC 2800 combines the room camera, Beamtracking microphone array, acoustic echo cancellation, audio processing, and loudspeakers in one device.

B. Independent operation: users connect a laptop at either table/wall position for HDMI presentation and USB conferencing. The selected encoder and decoder transport HDMI and USB over the AV network. The VBC 2800 appears to the laptop as one combined camera, microphone, and speaker device for Teams, Zoom, Google Meet, or similar applications.

C. Overflow operation: the room receives the selected Board Room video through the AMX AV-over-IP network. Program audio from the room decoder is converted/summed as required and connected to the VBC 2800 mono auxiliary input for reproduction through the integrated loudspeakers.

D. Room control: System On/Off, Input 1, Input 2, Input 3, Board Room Overflow, volume, and mute. Input selection shall route the associated HDMI and USB host connection together; only one BYOD laptop controls the VBC 2800 at a time.

E. The AMX N2600S endpoints provide the required networked USB 2.0 extension, so a separate USB extender is not included. Virtual Network USB shall be enabled and programmed, and the VBC 2800 and AMX endpoints shall use current approved firmware. The complete USB path shall be bench-tested with representative Windows and Mac laptops using Teams, Zoom, and Google Meet before installation. The VBC 2800 shall be configured for simultaneous USB and auxiliary audio operation.

1.7 AV NETWORK AND EQUIPMENT RACK

A. The central equipment rack is located in IDF 102 and contains the AMX controller and AV-over-IP interfaces, Cisco switch, Biamp DSPs, AVer tracking processor, Audio-Technica discussion controller, amplifier, assisted-listening equipment, patching, UPS, and power protection.

B. The managed AV switch carries AMX video, Dante audio, Biamp AVB audio, camera/control traffic, and overflow streams. Final VLANs, IP addressing, multicast settings, PoE requirements, network uplink, management access, and cybersecurity requirements must be coordinated and completed by District IT.

1.8 PRIMARY OPERATING MODES

A. Board Meeting - Discussion microphones, room audio, presentation displays, and automatic camera tracking operate together.

B. Presentation - The selected HDMI source is routed to the designated displays and presentation audio is reproduced in the room.

C. Hybrid / Stream - The owner computer receives room camera video, processed microphone audio, and selected presentation content.

D. Overflow - Board Room program video and audio are routed to Room 104, Room 106, or both.

Independent Classroom - Room 104 or 106 uses either local table/wall input and the Parlé VBC 2800 as one USB camera, microphone, and speaker device without affecting the Board Room.

1.9 REFERENCES & STANDARDS

A. Technical and Performance Standards: All systems engineering, execution, and performance criteria must fully comply with the following publications:

ANSI/AVIXA V202.01:2016 – Display Image Size for 2D Content in Audiovisual Systems (DISCAS)

ANSI/AVIXA 10:2013 – Audiovisual Systems Performance Verification

AVIXA A102.01:2017 – Audio Coverage Uniformity in Listener Areas

B. Electrical Standards: National Electrical Code (NEC) Article 725 (Class 1, 2, 3 Remote-Control, Signaling, and Power-Limited Circuits) and Article 800 (Communications Circuits). All active power electronics must be UL listed.

1.10 SUBMITTALS

A. Shop Drawings: Prior to installation, submit fully detailed operational schematic one-line signal flow diagrams, physical equipment rack layout elevations, device location floor plans, and graphical layout mockups of all custom user interfaces (UI) for touch panels and mobile control targets.

B. Product Data: Submit complete manufacturer specification datasheets for all active hardware components, explicitly highlighting specific ordering part codes, finish colors, and mounting kit options.

C. Testing and Commissioning Plan: Submit a written, structured step-by-step validation test procedure. Include specific check-boxes verifying Networked USB 2.0 extension paths, EDID matrix rules, Dante clock sync, and AVB multicast configurations.

1.11 QUALITY ASSURANCE

A. Contractor Qualifications: The selected AV Systems Integrator must possess a minimum of five (5) consecutive years of documented commercial enterprise-grade experience. The dedicated on-site lead technician must hold a valid, active AVIXA Certified Technology Specialist - Installation (CTS-I) certification.

B. Programming Credentials: All automation and audio DSP programming must be authored by a technician holding direct factory-certified active status for AMX (ACE) and Biamp (Tesira).

C. The AV integrator selected for this project is Pye Barker Fire and Security, 4670 Schantz Road, Allentown, PA (610) 439-1600.

D. The contractor shall provide in their bid the products and services of the specified AV integrator for this project.

1.12 WARRANTY & SERVICE

A. Coverage Period: Provide a minimum of one (1) full year of comprehensive turnkey parts and on-site labor warranty covering the complete integrated functional systems, beginning immediately at the signed date of substantial completion.

B. Service Response Metrics: Warranty service technical requests must receive remote acknowledgment within four (4) hours of notification. If a critical room-down failure cannot be solved remotely, an on-site service technician must arrive at the facility within twenty-four (24) business hours.

PART 2 – PRODUCTS

2.1 BOARD ROOM 108 EQUIPMENT SPECIFICATION

A. The contractor shall supply and install the exact hardware components listed below without substitution unless authorized in writing by the owner:

Qty	Manufacturer	Model / Part Number	Description	Project Placement Notes
2	NEC	PN-M982	98" 4K UHD Commercial Display	Front Wall main displays
2	Chief	XTM1U	Extra-Large Micro-Adjustable Tilt Wall Mount	For 98" displays
2	LG Electronics	50UL3G-E	50" 4K UHD Commercial Display	Rear wall display zone
2	Sanus	VLF620-B2	40"-90" Display Full Motion Bracket, Black	For 50" displays
1	AMX	AMX-CC3003	MU-3300 MUSE Automation Controller	Master system controller
1	AMX	FG423-48	PSR5.4, 12 VDC, 5.4 A Power Supply	Power supply for MUSE unit
2	AMX	AMX-UTP1011	VARIA-100 10.1" Touch Panel	1 for table, 1 for wall mounting
1	AMX	AMX-UMT1001	VARIA-ACS-100F Tabletop Stand for VARIA-100	Dais presentation control interface
1	AMX	AMX-TPC-IPAD	Authorized AMX Touch Panel Application	iPad control license for Owner iPad
2	AMX SVSI	AMX-N26E013	NMX-ENC-N2615D-WP, 4K60 MWC/Dante AV-A Encoder Wallplate	1 at front input wall, 1 at rear wall
3	AMX SVSI	AMX-N26E001	NMX-ENC-N2612S, 4K60 MWC/Dante AV-A & 1080p Encoder	3 at Dais, 1 for local streaming PC
5	AMX SVSI	AMX-N26D001	NMX-DEC-N2622S, 4K60 MWC/Dante AV-A & 1080p Decoder	4 for displays, 1 for streaming input capture
1	AMX	AMX-FGN9102	NMX-ACC-N9102 1RU Rack Shelf for Multi-Endpoints	Racking for encoders/decoders
9	AMX	AMX-FGN9101	AMX NMX-ACC-N9101 Mounting Bracket	Endpoint structural mounting hardware

1	Biamp	TesiraFORTÉ DAN CI	Digital Signal Processor with AEC, Dante, 12-In/8-Out	Main audio DSP headend unit
18	Biamp	Desono CM60DTD	6.5" Recessed Ceiling Loudspeakers	Distributed across 4 mix zones
1	Biamp	Voltera D 1200.4	4-Channel Power Amplifier	Powers distributed speech system
1	Biamp	Tesira EX-UBT	PoE AVB/USB Audio Extender	Dais connection for web-conferencing
1	AVer	CAM520 Pro3	High-Definition Optical Zoom PTZ Camera	Main tracking conferencing camera array
3	AVer	CAM520	CAM520 Pro3 PTZ Cameras	Dais, podium, and audience coverage views
1	AVer	MT300N	NDI Matrix Tracking Box	Processes microphone tracking logic to recall presets
1	AVer	PMT300NRM	AVer Rackmount Bracket for MT300N	Headend enclosure placement
1	Cisco	C9300L-48P-4X-E	Catalyst 9300 48-Port PoE+ L3 Managed Switch	Dedicated closed AV system network
1	ICC	ICMPP48C6A	CAT6A 48-Port Feed-Through Patch Panel, 2RU	Central interconnect infrastructure
1	Williams AV	BA SYS2-00	Assisted Listening System Kit w/ 4 Receivers	ADA compliant hearing accessibility setup
1	Audio-Technica	ATUC-50CU	ATUC-50 Central Control Unit	Dais microphone discussion headend
12	Audio-Technica	ATUC-50DU	ATUC-50 Discussion Base Unit	Dais board-member station interface
12	Audio-Technica	ATUC-M43H	Gooseneck Microphone Element	Provides close speech pickup at Dais
1	Shure	ULXD4D	Dual-Channel Digital Wireless Receiver	Wireless microphone headend receiver
1	Shure	ULXD8	Wireless Gooseneck Base Transmitter	For location flexibility at the Podium
1	Shure	MX415	Microflex 15" Modular Gooseneck Microphone	Mounted to the Shure wireless base
1	Shure	ULXD2/SM58	Digital Handheld Transmitter with SM58 Capsule	For audience roaming Q&A participation

1	Shure	SBC200	Rechargeable Battery Docking Station	Dual dock for wireless microphone cells
1	Shure	SBC-DC	Power Supply for SBC200 Dock	Local power for battery station
2	Shure	UA844SWB	Wall-Mounted Wideband Antenna Splitter System	Ensures high-gain wireless coverage in room
1	Shure	UA8100	100' Low-Loss Antenna Cable	Far wall antenna feeder path
1	Shure	UA850	50' Low-Loss Antenna Cable	Near wall antenna feeder path
1	Juice Goose	JC8.0L	Rack Power Distribution	Power sequencing at central equipment stack
1	SurgeX	SX1120RT	Power Conditioner / Surge Eliminator	Protects headend components against surges
1	SurgeX	UPS-1000-OL-2	1000VA Online Double-Conversion UPS	Provides continuous clean battery reserve power
1	Lowell	LGR-2427	Enclosed Rack 24U x 27"D	Main standard structural equipment cabinet
1	Lowell	LFD-24FV	Vented Door 24U	Perforated front rack protection
1	Lowell	RRD-24	Rack Rails 24U 1PR	Secondary inner structural vertical mounting kit
1	Lowell	LMB-27	Mobile Base 27"D	Allows service rotation access in IDF 102
1	Lowell	ACS-1512	Power Strip 15A 12-Outlet	Internal rack vertical distribution bar
1	Lowell	UDP-214	Rack Drawer w/ Lock 2U x 14"D	Stores system documentation, wireless mics, spares
1	Lowell	SVSP-1CC	Steel Vent Panel 1U 12-pk	Maintains proper thermal cross-ventilation

2.2 **HISTORIC CLASSROOM 104 EQUIPMENT SPECIFICATION**

Qty	**Manufacturer**	**Model / Part Number**	**Description**	**Project Placement Notes**
1	LG Electronics	86UL3G-E	86" 4K UHD Commercial Display	Main local presentation screen

1	Chief	XTM1U	Extra-Large Micro-Adjustable Tilt Wall Mount	Requires architectural historic confirmation
2	AMX SVSI	AMX-N26E001	NMX-ENC-N2612S, 4K60 Encoders	Mounted underneath tables for local source entry
1	AMX SVSI	AMX-N26D001	NMX-DEC-N2622S, 4K60 Decoders	Table inputs and Board Room overflow tracking
3	AMX	AMX-FGN9101	AMX NMX-ACC-N9101 Mounting Bracket	Endpoint physical framing kit
1	AMX	MCP-108-WH	Massio 8-Button Wall Controller with Knob (White)	Flush-mounted wall operational interface
1	AMX SVSI	AMX-N26E013	NMX-ENC-N2615D-WP Encoder Wallplate	Wall-mounted input plate position
1	Biamp	Parlé VBC 2800	Premium Conferencing Video Bar	Integrated camera, beamtracking audio, speaker array
2	Misc Component	15' HDMI	15' High-Speed HDMI Patch Cable	Provided at tables for BYOD user connection
2	Misc Component	15' USB-C	15' USB-C Premium Data Cable	At tables for unified USB extension
1	Misc Component	6' HDMI	6' High-Speed HDMI Patch Cable	Local decoder to main display interconnection
1	Misc Component	6' USB-C	6' USB-C Data Cable	Connects display path to conferencing hardware
1	Misc Component	6' RS-232	6' Serial DB9 Display Control Cable	Enables hardware automation link to display
1	West Penn Wire	Cat6	Category 6 Bulk Cable - Plenum Rated	All intra-room horizontal pathway runs

2.3 **HISTORIC CLASSROOM 106 EQUIPMENT SPECIFICATION**

Qty	**Manufacturer**	**Model / Part Number**	**Description**	**Project Placement Notes**
1	LG Electronics	86UL3G-E	86" 4K UHD Commercial Display	Main local presentation screen
1	Chief	XTM1U	Extra-Large Micro-Adjustable Tilt Wall Mount	Requires architectural historic confirmation

2	AMX SVSI	AMX-N26E001	NMX-ENC-N2612S, 4K60 Encoders	Mounted underneath tables for local source entry
1	AMX SVSI	AMX-N26D001	NMX-DEC-N2622S, 4K60 Decoders	Table inputs and Board Room overflow tracking
3	AMX	AMX-FGN9101	AMX NMX-ACC-N9101 Mounting Bracket	Endpoint physical framing kit
1	AMX	MCP-108-WH	Massio 8-Button Wall Controller with Knob (White)	Flush-mounted wall operational interface
1	AMX SVSI	AMX-N26E013	NMX-ENC-N2615D-WP Encoder Wallplate	Wall-mounted input plate position
1	Biamp	Parlé VBC 2800	Premium Conferencing Video Bar	Integrated camera, beamtracking audio, speaker array
2	Misc Component	15' HDMI	15' High-Speed HDMI Patch Cable	Provided at tables for BYOD user connection
2	Misc Component	15' USB-C	15' USB-C Premium Data Cable	At tables for unified USB extension
1	Misc Component	6' HDMI	6' High-Speed HDMI Patch Cable	Local decoder to main display interconnection
1	Misc Component	6' USB-C	6' USB-C Data Cable	Connects display path to conferencing hardware
1	Misc Component	6' RS-232	6' Serial DB9 Display Control Cable	Enables hardware automation link to display
1	West Penn Wire	Cat6	Category 6 Bulk Cable - Plenum Rated	All intra-room horizontal pathway runs

2.4 CABLING & LINE INFRASTRUCTURE STANDARDS

A. Horizontal Signal Runs: All horizontal network lines dedicated to high-bandwidth AMX SVSI video encoding, Dante audio transmission, and Biamp AVB streaming must be installed using premium Shielded Twisted Pair Category 6A (Cat6A STP) or verified bulk West Penn Wire Plenum Cat6 infrastructure as indicated per space.

B. Fire and Safety Ratings: All horizontal runs distributed across architectural drop ceilings, raised floors, or environmental air plenum cavities must carry a certified CMP plenum rating to satisfy municipal structural fire protection guidelines.

PART 3 – EXECUTION

3.1 FIELD QUALITY CONTROL & PRE-INSTALLATION TESTING

A. Mandatory Shop Bench-Testing: Prior to shipping components to the project site, the contractor must mount, interconnect, and bench-test the complete operational system within their specialized facility.

B. Virtual USB Path Validation: The complete end-to-end USB pathway—comprising the AMX N2600S networked virtual USB 2.0 endpoints and the Biamp Parlé VBC 2800 conferencing bars—must undergo intensive validation testing. The contractor shall verify transparent hardware enumeration using representative physical Windows and macOS laptops running live active calls across Microsoft Teams, Zoom, and Google Meet applications. The system shall not be delivered to the site until this functional sequence executes without data drops or component dropouts.

3.2 STRUCTURAL INSTALLATION & HISTORIC CONDITIONING

A. Structural Mount Rigging: Securely anchor all Chief XTM1U extra-large heavy-duty tilting wall brackets to underlying structural wall studs or backing plates using approved lag hardware. Perform load-bearing certification checks before final display attachment.

B. Historic Preservation Constraints (Rooms 104 & 106): Classrooms 104 and 106 are historically sensitive architectural environments. The AV Contractor must closely coordinate all surface raceway paths, box configurations, and structural surface penetrations with the project architect prior to tool deployment. Core drilling, anchor tapping, or saw-cutting into historic millwork, vintage plaster, or protected masonry elements is strictly prohibited without explicit written administrative sign-off.

C. Rack Integration Standards: Install the Lowell LGR-2427 enclosure level and true within IDF 102. Bundle, path, and comb all vertical and horizontal line dress arrays neatly using hook-and-loop fasteners. Maintain strict separation between low-voltage signal lines (HDMI, Cat6, Line Audio) and AC power lines to isolate potential electromagnetic tracking artifacts.

3.3 LOGICAL SOFTWARE PROGRAMMING & CONTROL DESIGN

A. Board Room 108 System Operating Modes: The software code inside the AMX MUSE engine must present clean macro-driven scripts supporting four operational room states:

Board Meeting Mode: Energizes the full Audio-Technica discussion array, links room speech lift to the 18 distributed ceiling speakers across four distinct output zones, fires up the NEC 98" and LG 50" displays, and activates the AVer MT300N tracking processor. The system must automatically map mic gating status from the Shure MXA920 overhead arrays and the Audio-Technica tables to direct smooth PTZ automated tracking changes across the three AVer CAM520 Pro3 cameras.

Presentation Mode: Routes selected physical HDMI inputs from table/wall stations to designated display zones while setting appropriate stereo equalization profiles for program audio playback.

Hybrid / Stream Mode: Bridges local multi-mic microphone matrix audio from the Biamp TesiraFORTÉ along with selected active video mixes directly into the dedicated District-furnished local web-conferencing computer via the capture bridge.

Overflow Mode: Encodes Board Room 108's active video and programmatic master audio and routes it across the switch fabric to Classrooms 104 and 106.

B. Classrooms 104 & 106 Operation Logic: The AMX Massio MCP-108 wall keypads must manage room states locally. Toggling a local presentation source must instantly link the physical tabletop HDMI/USB-C patch paths to the Biamp Parlé VBC 2800 bar via the AMX virtual network USB matrix. Programming must prevent concurrent BYOD control contentions by locking out secondary connections. When the 'Board Room Overflow' button is engaged, the local screen must display the AMX stream from Board Room 108, and the audio must sum down to mono to feed the auxiliary input of the local Parlé VBC 2800 bar.

3.4 IT NETWORK & SECURITY COORDINATION

A. Multi-Protocol Switch Setup: The contractor must work hand-in-hand with District IT personnel to build out the Cisco Catalyst switch. Program robust configurations to support simultaneous, conflict-free operations across multiple network protocols, including AMX SVSI Multicast Video (IGMP snooping/querier rules), Dante Digital Audio (AES67 clocking profiles), and Biamp AVB (IEEE 802.1BA Time-Synchronization). Document all network segmentation, security port locks, IP assignments, and VLAN boundaries within the final system configuration records.

3.5 TESTING, COMMISSIONING & CLOSING PROCEDURES

A. Audio-Visual Synchronization: Measure and verify end-to-end processing delays. Under all operational mode pathways, lip-sync alignment must adhere strictly to SMPTE 170M guidelines: absolute audio lead must remain under 45ms, and absolute audio lag must remain under 125ms.

B. Closeout Turnover Deliverables: Provide a complete set of 'As-Built' wiring diagrams, uncompiled/compiled source code for DSP and control systems, manufacturer manual packages, and an inventory sheet noting all MAC and IP address details.

C. Instructional Systems Training: Deliver a minimum of two (2) hours of dedicated, video-recorded training for District staff covering daily operations, system startup/shutdown procedures, and basic field troubleshooting.

END OF SECTION 27 40 00

SECTION 27 51 29 – AREA OF REFUGE SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 The Contractor shall furnish and install all ADA 100 Area of Refuge System equipment including, but not limited to, outlet boxes, conduit, wiring, telephones, Master Station and Area Stations as shown on the plans, and all other equipment necessary to provide a complete and operating Area of Refuge system for the project. Equipment furnished under the terms of this specification shall be the standard product of a single manufacturer.

1.3 Housing Devices Inc., 407 R. Mystic Avenue, Medford, MA 02155 (800-392-5200) shall be considered as Basis of Design. If the alternate system fails to provide all the requirements specified in this document, the Contractor shall be responsible for all costs associated with the removal and replacement of said equipment.

A. The system shall be vandal resistant, manufactured of 16 gauge (0.062) 304 stainless steel and comply with the Americans with Disabilities Act sections 4.3.11.4 and 4.3.11.5.

B. The Master Station and Area Stations shall be custom engraved (not silk screened or stamped).

C. The Area Station shall have a large domed, stainless steel engraved “3” diameter momentary pushbutton with the words, “PUSH FOR HELP” backfill painted in bright red. Said button shall be “heavy duty” and the surface engraving shall be deep enough to withstand extreme conditions. It shall be activated with a minimum of effort and engineered so that it may be depressed from any angle for ease of use provided. No other hardware shall protrude from the station as high as the pushbutton.

D. The system shall be modular and expandable to include future Area Stations.

E. The wire shall be 7 conductor 3 pair + one conductor 20 AWG with an overall shield HDI part #HDI ADA-S.

1.4 SUBMITTALS

A. Data sheets on all equipment shall be provided.

B. Internal control cabinet drawings showing internal block diagram connections shall be provided.

C. Wiring diagrams showing typical field wiring connections shall be provided.

1.5 QUALIFICATIONS

A. The Contractor shall be from an established business that has been operating in the area for a minimum of five years.

B. The Contractor shall show evidence that he maintains a service organization and parts inventory to adequately support the supplied equipment.

1.6 MAINTENANCE SERVICE

A. The Contractor shall provide a one year guarantee of the installed system against defects in material and workmanship. All contractor labor and materials shall be provided at no expense to the Owner. Guarantee

period shall begin on the date of acceptance by the Owner or Engineer.

B. The System Manufacturer shall warranty the installed system's components against defects in material and manufacturer's workmanship for a period of one year from date of the system's shipment from the Manufacturer to the Contractor, Owner, Engineer or other specified receiving authority. Replacement or repair of system components only (job-site labor not included) shall be at the Manufacturer's discretion and provided at no expense to the Owner (shipping costs at other than standard ground rates will be the Owner's responsibility).

1.7 QUALITY ASSURANCE

A. The Contractor shall currently maintain a locally run business for a minimum of five years and shall be an authorized distributor of the supplied equipment with full warranty privileges.

B. The Contractor shall maintain at his facility the necessary spare parts in the proper proportion as recommended by the equipment Manufacturer to maintain and service the equipment being supplied. This facility shall be available for inspection by the Engineer.

C. The supplying Contractor shall have attended the Manufacturer's installation and service school or have been authorized by the Manufacturer to install the equipment.

D. The Contractor shall furnish Manufacturer's manuals of the completed system including individual specification sheets, schematics, inter-panel and intra-panel wiring diagrams. In addition, all information necessary for the proper operation of the system must be included. Any bidder using other than the specified equipment must provide this information prior to bidding.

E. As built drawings that include any changes to wiring, wiring designations, junction box labeling and any other pertinent information shall be supplied upon completion of project.

1.8 IN SERVICE TRAINING

A. The Contractor shall furnish training with the system. These sessions shall be broken into segments that will facilitate the training of individuals in operating the Master Station as well as Area Stations. Operating manuals and users guides shall be provided at the time of the training.

1.9 WIRING:

A. System wiring shall be in accordance with good engineering practices as established by the EIA and NEC. Wiring shall meet all established state and local electrical codes. All wiring shall test free from shorts and grounded as specified.

B. System wiring shall be accomplished using labeled, captive screw, plug-in connectors and 20 AWG shielded twisted pairs for all connections.

1.10 BASIC SYSTEM OPERATION

A. When the system is in normal operating mode, the Master Station shall display an illuminated "green" LED system ready light indicating the system is functioning and operating correctly. When operated, the system shall provide two-way audio and visual communications between the Master Station location and each Area Station initiating a request for help. Communication at each Area Station shall be hands-free after initial contact from the Area Station.

B. When a "call for help" is placed by an Area Station, the system shall initiate audio and visual alarms at both the Master Station and each of the affected Area Stations. The audible alarm shall be at least 90 decibels and the visual display shall be indicated by a SuperBrite® LED light and surface engraved or attached engraved location name (ID) directory of the calling Area Station.

C. Communication is established by simply answering via the Master Station. When communication is completed and the Master Station communication link has been broken, the LED display will continue to show the Area Station location (ID) until the system has been reset at the Master Station.

D. When a “call for help” is placed by an Area Station, several indications must be provided at the Area Station to assure the caller that the call is being processed. After pressing the 3” “PUSH FOR HELP” call button the caller will be provided with both an audio and visual confirmation. A “HELP REQUESTED” LED shall illuminate and an alarm will sound at both the Area Station and the Master Station. When the security attendant at the Master Station has answered the call, the “HELP COMING” LED will illuminate and the security attendant’s voice can be heard through the speaker at the Area Station. Full two-way voice “hands-free” communication shall be provided at the Area Stations. The caller simply talks in the direction of the Area Station speaker, which acts as a microphone and enables the caller’s voice to be reproduced at the Master Station. Upon completion of the call, a LED on the Area Station indicating “HELP COMING” shall remain illuminated, providing visual indication that the “HELP REQUESTED” LED is acknowledged from the Master Station. The LED will not extinguish until building personnel have reported to the Area of Rescue Assistance and the system has been reset. Resetting the system shall be accomplished by turning a momentary key switch at the Master Station. The system shall also incorporate a momentary key switch at the Area Station if required (optional).

PART 2 - PRODUCTS

2.1 The installation shall include a supervised based Area Station communication system consisting of a Master Station capable of handling any number of Area Stations. The system shall be equipped for the number of stations shown on floorplans and have capacity for future installations if desired.

2.2 MASTER STATION

A. The Master Station shall be constructed of 16 gauge (0.062) 304 stainless steel. The station faceplate shall be 11”W x 11”H (larger for systems with more than 5 Area Stations), be capable of surface or flush mounting and utilize tamper proof mounting hardware. It shall include the following:

1. Panel capacity for the specified number of Area Stations.

2. Two 7/16” diameter flat metal buttons (“TALK”, “LISTEN”) per Area Station to initiate and respond to a request for assistance from each specific Area Station in the system.

3. When in standby mode, a “green” LED shall be illuminated to indicate the system is operational. Depressing the “TALK” button shall illuminate a “HELP COMING” LED at the respective Area Station, silence the piezoelectric alarm, and open up two-way voice communication between the Master Station and Area Station(s).

4. Two SuperBrite® colored LEDs per Area Station to visually indicate “HELP REQUESTED” (red LED) or a line fault (amber LED) for each specific Area Station in the system, and to indicate that a fault has occurred at a particular Area Station(s), wiring between Area Station(s) and Master Station, or other system components shall be provided.

5. A piezoelectric alarm shall generate a 90 dbA signal sounding through the Master Station to aurally indicate “HELP REQUESTED” from an Area Station.

6. An audio confirmation signal shall be generated from the Master to the Area Station to acknowledge the request for assistance.

7. Acknowledgement of the “HELP REQUESTED” call from the Area Station to the Master Station shall also be indicated at the Area Station by the illumination of a red LED (“HELP COMING”) on the Area Station.

8. The system shall be able to provide an optional set of N/O dry contacts (if specified) for connection to a secondary Master Station, paging system, fire alarm system, or other optional devices such as a DTMF telephone dialer. All communication between Master Station or DTMF telephones shall be non-blocking.

9. The system shall have the capability to add Master Stations and sub-annunciator panels as specified.

10. It shall be possible to redirect “HELP REQUESTED” calls to a secondary Master Station or outside telephone line if there is no answer at the primary Master Station.

11. Provide battery backup capable of sustaining equipment for 90 minutes under normal operating conditions, and 24 hours in standby mode.

2.3 AREA STATIONS

A. The Area Station assembly shall be constructed of 16 gauge (0.062) 304 stainless steel. The station faceplate shall be 9”W x 9”H, be capable of surface or flush mounting and utilize tamper proof mounting hardware. The faceplate shall have the following features:

1. A large 3” diameter domed stainless steel momentary pushbutton surface engraved and backfill painted in bright red the words “PUSH FOR HELP”. It shall be activated with a minimum of effort and engineered so that it may be depressed from any angle for ease of use provided. No other hardware shall protrude from the station as high as the pushbutton.

2. Two “SuperBrite®” red colored LEDs shall visually indicate and confirm request status to the caller with the words “HELP REQUESTED” and “HELP COMING” surface engraved and backfill painted as labels next to each LED.

3. A 3” mylar 45 ohm speaker shall be provided.

4. A piezoelectric alarm shall generate a 90 dbA signal sounding through the Area Station to aurally indicate “HELP REQUESTED” from an Area Station.

5. An optional momentary type keyed reset switch shall also be provided, if required. The reset switch will provide the means to reset the “HELP COMING” LED at the Area Station and also reset the corresponding area’s red LED on the Master Station in order to ensure response by building personnel to the caller at the Area Station.

6. Braille Instructional Signs (optional) shall be provided for each Area Station. Signs shall be tactile lettering & rastor braille with tamper proof mounting hardware. Text shall conform with the Americans with Disabilities Act Sec. 40.30.4 for text size and style, be in Braille and English, and read: “FOR ASSISTANCE PUSH 3 INCH HELP BUTTON”.

PART 3 - CABLES

3.1 All cable shall be as recommended by the manufacturer on an approved equivalent. All Area Station wiring must be home run with individually jacketed cable.

3.2 Area Station wiring shall be 7 Conductor (3) 20AWG overall shielded twisted pair + 1 conductor. Recommended wire HDI ADA-S or equal.

3.3 Master Station wiring shall be 7 Conductor (3) 20AWG overall shielded twisted pair + 1 conductor. Recommended wire HDI ADA-S or equal.

3.4 Three (3) 20AWG conductors for each Area Station are also required. Recommended wire HDI ADA-S or equal.

3.5 All cables run in underground conduits must be suitable for wet locations and appropriately grounded as per EIA and NEC recommendations. See wiring diagrams for details.

PART 4 - INSTALLATION

4.1 Complete system shall be installed in strict accordance with manufacturer's recommendations.

4.2 All wiring shall be installed in raceways where routed through ceiling areas.

4.3 Master Station and Area Station mounting shall be in accordance with the ADA recommendations and specifications.

PART 5 - INSPECTION AND TEST UPON COMPLETION

5.1 System field wiring diagrams shall be provided to the Contractor by the system Manufacturer prior to installation.

5.2 Upon completion of the installation, four (4) copies of complete operational instructions shall be furnished, complete with record drawings. Instructions shall include part numbers and name, address, and telephone number of parts source.

5.3 Upon completion of the installation of the equipment, the Contractor shall provide to the Engineer a signed statement that the system has been wired, tested, and functions properly according to the specifications.

5.4 Nothing herein contained shall be construed to relieve the Contractor from furnishing a complete and acceptable electrical wiring system in all its categories. The Engineer will reject any materials or labor which are or may become detrimental to the accomplishment of the intentions of these specifications.

END OF SECTION 275129

SECTION 27 77 00 – DISTRIBUTED ANTENNA SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. 700/800 MHZ Antenna System

1.3 SYSTEM DESCRIPTION

A. Design Requirements

1. Furnish and install and 700/800 MHz Emergency Radio Repeater System.
2. The system must meet the requirements of Berks County, Pennsylvania. Verify frequency band with AHJ prior to ordering system.

    a. Compliant Public Safety In-Building Two-Way Radio Communications Enhancement Systems Requirements.
3. Include all labor, materials, equipment and services required for complete installation and related work as specified in this Section including (but not limited to) connection of all circuits, apparatus, and equipment required to deliver completely operable system to the owner, ready for use.
4. Pathway will be provided from the existing donor antenna location to the system head end.
5. System design shall take into account:
    a. External macro signals.
    b. Potential sources of interference.
    c. Actual billing construction materials.
    d. Expected traffic in every area and density will be provided to accommodate a 30% increase in capacity.
6. BDA shall be located to minimize disruptions to other systems.
7. Perform and provide a RSSI signal level map at the donor location and provide a detailed system design that will meet the coverage and capability requirements of the County. System shall be designed to provide better than 95 dBm coverage to no less than 95% of the structure.
8. The system shall consist of an NFPA 72-2010, Chapter 24 and IFC 510.1 compliant Cobham D-MBR-3707-3708 PS-NFPA Digital multi-channel RF Signal Booster/DBA with a discrete distributed antenna system and donor antenna system. Areas that typically need to be evaluated for poor communications are below grade rooms, parking garages, elevators and areas surrounded by metal and/or concrete. Radio Repeater System shall support the city's First Responder radio network frequencies. It shall operate at the Fire Command Centre and elevators, elevator lobbies, emergency and standby power rooms, standpipe hose connection locations, the building engineer's office, mechanical rooms, elevator equipment rooms, fire pump rooms, areas of refuge, entries into required exit stairways, rooms containing the main electrical service disconnecting means, stair enclosures, penthouses, and basements shall also be transparent to communications signals. Amplifiers shall be powered by a dedicated uninterruptible power source (UPS) with a minimum backup time of twelve (12) hours with all amplifiers at rated output. The UPS input circuit shall be a dedicated circuit and connected to the emergency/standby generator. The circuit shall be provided with a listed "lock on" device.

B. Performance Requirements

1. Provide fully integrated and operational system capable of forward and reverse operations.

a. Ensure overall performance of system does not interfere with local cable service provider's operations.

b. Provide each part of system complete in detail and operable in unison with all other sections, providing a completely installed television distribution system and connections as described in this Section.

c. Provide all work, materials, and manner of placement in strict accordance with requirements of latest edition of National Electrical Code.

d. Provide all materials listed as complying with available standards of Underwriter's laboratories or other similarly established standards and carry their label. Apply all materials in strict accordance with Underwriter's laboratories listing.

e. All work described in this Section performed by Contractor or approved qualified subcontractor.

f. The Radio Repeater System shall be FCC approved and amplify the county's two-way radio signals to provide adequate radio coverage throughout the building or structure for the first responders.

g. The system shall be provided in accordance with the applicable International Fire Code and its amendments.

h. Provide necessary donor antenna(s) on the roof level.

i. All cable entry points shall be grounded and lightning arrestors shall be installed per R-56 standard.

j. All equipment shall be grounded per R-56 standard.

k. Provide fire rated coaxial cable with connectors from the roof level down to system head end equipment.

l. Provide plenum rated ½ inch coaxial cable with connectors for all horizontal runs. All materials installed in the plenum including passive devices, hangers, and ties shall be plenum rated.

m. Provide plenum rated fiber optic cable and connectors meeting manufacturer's recommendations for all fiber runs.

n. Fire stopping shall be installed at any new or existing firewall penetrations.

o. All passive system components including but not limited to splitters, taps, directional couplers and indoor antennas shall support 700 MHz to 2500 MHz.

p. All equipment and materials shall be installed according to manufacturers' recommendations.

q. All equipment and materials shall be new, not discontinued, and have at least a one year warranty.

r. All labor must be warranted for workmanship defects for a minimum period of one year.

s. Installation shall be coordinated with the County Emergency Responders and Muhlenberg School District to ensure their macro radio network is not disrupted.

1.4 SYSTEM DESCRIPTION

A. Product Data

1. Submit manufacturer's latest publication, part numbers and quantity listing of all supplied components:

    a. Splitters and Directional Couplers.

    b. Cable types.

    c. Amplifiers.

    d. Antennas.

    e. Roof mounted antennas.

B. Shop Drawings

1. Contractor shall submit original specification sheets or clear copies of the same on all items. Manufacturer's name, make and model number shall appear on each sheet. Submittals shall be indexed and presented in a neat and logical order in a binder. Submittals shall contain installation, operation and programming manuals of the proposed equipment and systems to provide the Authority and Design consultant complete information as to system features, functions and capabilities
2. The Contractor shall submit line drawings of all systems showing major components of the systems. Submit wiring diagrams showing typical connections for all systems and equipment.
3. The Contractor shall submit to the Design consultant for approval, prior to the installation of any part of the video distribution system, design consultant drawings of the system showing the interconnections of all equipment with the designed video distribution system with calculated signal levels. Specification sheets covering all component parts of the system shall be submitted along with the design consultant drawings. The system and equipment as shown on the design consultant drawings and specification sheets shall meet all items of the specifications.
4. System design documentation including design assumptions, power budgets, system block diagram, and floor plans showing cable routing, antenna locations, and equipment locations.
5. Product data sheets for all electronic equipment, fiber and coaxial cable, splitters, couplers and antennas.
6. Bill of materials including equipment and materials lead times.
7. Four references for prior Public Safety in-building reinforcement system installations.
8. Resumes for Design Engineer, Project Manager, and Installation Supervisor.

C. As-Built Drawings

1. Provide riser drawings of complete system including all device locations and cabling.

2. Provide 1/8" scale drawings in hardcopy and electronic format for review and acceptance by the Architect and Owner.

1.5 QUALITY CRITERIA

A. Qualifications

1. All work in conjunction with this installation shall be in accordance with good design consultant practices. The installation shall be in accordance with the latest requirements of the National Electrical Code, State and local codes, ordinances and regulations of any other governing body having jurisdiction.

2. The Contractor shall submit a list to include at least five of the Contractor's Installation of the proposed Video Distribution systems, which have been in satisfactory operation for a minimum period of three years.

3. All system equipment shall be limited to the products regularly produced and recommended for service ratings in accordance with design consultant data or other comprehensive literature made available and in effect at the time of bidding.

4. The Contractor shall have been in the video distribution system integration installation business not less than 5 years prior to the bid date.

5. The Contractor shall be an authorized distributor for the proposed equipment and system with full manufacturer's warranty privileges.

6. The Contractor shall maintain a complete inventory of all parts necessary for satisfactory service and maintenance of the proposed system.

7. The Contractor shall provide equipment of one manufacturer for the system and bulletin board components of the video distribution system unless specifically approved in writing by the Design consultant.

B. Regulatory Requirements

1. Regulations, Standards and Publications:

a. NFPA 72-2013

a. 24.5.2 Two Way Radio Communications Enhancement Systems

b. 10.5.1 System Designer

c. 10.5.2 System Installer

d. 10.5.3 Inspection, Testing and Service Personnel

e. 10.6.7 / 10.6.7.3.1 Secondary Power Supply

f 14.4.10 In-Building Emergency Radio Communications Systems (testing)

g. A. 14.4.10 In-Building emergency radio communications systems testing annex.

h. IFC 2018

i. NFPA 70, "National Electrical Code" Articles 810 and 820

j. ANSI/TIA – 568C "Telecommunications Standard for Pathways"

k. IEEE Standard No: 205-2001

l. BICSI Telecommunications Distribution Methods Manual (TDMM), Latest Edition

2. System wiring shall be in accordance with good design consultant practices as established by the EIA and NEC. Wiring shall meet al established State and local electrical codes. All wiring shall test free from grounds and shorts.

1.6 QUALITY ASSURANCE

A. Conditions for Consideration of "Or Equal" Products: Where products are specified by name and accompanied by the term "or equal", the proposed "or equal" product will be considered when the following conditions are satisfied. If all the following conditions are not satisfied, Design Consultant will return requests without action, except to record noncompliance with these requirements:

1. Proposed product does not require extensive revisions to the Contract Documents.

2. With the exception of the product name or number and manufacturer's name, proposed product conforms with requirements indicated on the Drawings and in the Specifications in every respect and will produce indicated results.

3. Proposed product is fully documented and properly submitted.

4. Proposed product has received necessary approvals of authorities having jurisdiction.

5. Proposed product is compatible with AND has been coordinated with other portions of the Work.

6. Proposed product provides specified warranty.

7. If proposed product involves more than one contractor, proposed product has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

8. Submission is accompanied with detailed comparison of significant qualities of proposed product with those named in the Specification. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

9. Submission is accompanied with a list of similar installations for completed projects with project names and addresses and names and addresses of design consultants and authorities, if requested.

10. Submission is accompanied with proposed product's Manufacturer signed written statement on Manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in good condition, store in a dry place, off ground, and keep dry at all times.

B. Materials should be clearly marked with project name, number and Contractor's name.

C. If equipment is dropped and damaged, it is to be replaced at the contractor's expense.

1.8 WARRANTY

A. The Contractor shall warrant the equipment to be new and free from defects in materials and workmanship and will, within two years from the date of acceptance, repair or replace all or any part of the equipment found to be defective. Warranty maintenance, shall be provided by the Contractor during normal working hours at no expense to the Authority.

B. At the completion of the job and before final acceptance, the Contactor shall guarantee in writing that the systems are properly adjusted and shall warrant the systems free from defects for a period of two (2) years from the date of Final Acceptance by the Authority. In addition, the Contractor shall provide a guaranteed service response time of not more than 48 hours from the time of receipt of a trouble call. Service and maintenance during the two-year warranty period shall include all parts and labor and shall be at no additional cost to the Authority.

1.9 AUTHORITY'S INSTRUCTIONS

A. A comprehensive installation, operation, programming and instruction manual shall be supplied as part of the system. The manual shall provide complete service information, including schematics, layout drawings, and interconnecting diagrams showing the location of all the outlets, cable taps, cable routes, and other installed components. Include final "as built" one line system drawings. Include for this particular project parts lists to permit quick and efficient maintenance and repair of the equipment by qualified technicians. Manuals shall include 8-1/2" x 11" device location/cabling route drawings provided in CAD format (AutoDesk – AutoCad 2015 or later). Manuals shall include a copy of the operations manuals.

Manuals shall be indexed and neatly bound in a hardcover three ring binder. Three (3) copies of this manual shall be provided to the Authority upon project completion. Contractor shall retain a minimum of one (1) copy for their permanent records.

1.10 COMMISSIONING

A. Authority reserves the right to determine the final approval of the system at the time of scheduled job completion. Failure to meet the installation schedule or provide the “precise functional equivalent” shall result in the removal of the system at the Contractor’s expense.

B. The Contractor shall furnish 3 – four (4) hour sessions of in service training with the system. Operating manuals and user guides shall be provided at the time of the raining. Provide a minimum of three operation manuals.

1.11 MAINTENANCE

A. The Contractor or his subcontractor shall show satisfactory evidence, upon request, that he maintains a fully equipped service organization, capable of furnishing adequate inspection and service to the system, including standard replacement parts He or his agent shall be prepared to offer a service contract for the maintenance of the system after the guarantee period.

B. Diagrams: The Contractor shall furnish three complete sets of operating instructions, including cable diagrams, and other information necessary for proper installation, operation and maintenance of the system components. As-built drawings of the system shall be supplied. These drawings shall include signal levels measured throughout the system as they were at the acceptance date of the system.

C. Service Calls: Provide 8 hours of service calls on system in school after final acceptance to make any adjustments necessary to keep system at peak operation condition. Service calls performed as requested by the owner. Warranty work is not included in the service call time.

D. Service Contract: Equipment Supplier: Accredited by proposed equipment manufacturers and prepared to offer service contract for system maintenance on completion of guarantee period and provide names, locations, and size of 10 recent successful installations in area; 24 hours per day service, with 24 hour non-emergency service response time provided, and including 1 hour emergency call response time on 365-day-per-year, 24 hours per day basis.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Radio Repeater System:

1. Cobham Wireless and LMR shall be the basis of design.
2. Any products submitted as equals must be approved by the designer prior to approval and purchase.

B. RFS ICA 12-50JPL ½” ClearFill Plenum Rated Air-Dielectric Coaxial Cable for in-building applications.

C. 700/800 MHZ Cobham D-MBR 3707-3708 PS-NFPA RF Signal Booster/BDA

1. With 24 hour battery back-up system. (BBU-400W-24H).
2. Internet connection
3. Wireless Modem.

D. Commscope Cellmax-ext-cpuse 698-960 MHZ Directional Outdoor Antenna

E. Commscope Cellmax-o-cpuse 698-960 Omni Indoor Antenna

F. Commscope Cellmqax-d-cpuse 698-960 Directional Indoor Antenna

G. Commscope Splitters

1. S-2-CPUSE-L-N-2-Way Low Power Splitter

2. S-2-CPUSE-L-N-3-Way Low Power Splitter

3. S-4-CPUSE-L-N-4-Way Low Power Splitter

H. Commscope Directional Couplers

1. C-6-CPUSE-N 6 dB directional coupler

2. C-10-CPUSE-N 10 dB directional coupler

3. C-15-CPUSE-N 15 dB directional coupler

4. C-20-CPUSE-N 20 dB directional coupler

5. C-30-CPUSES-N 30 dB directional coupler

PART 3 - EXECUTION

3.1 ACCEPTABLE INSTALLERS

A. Contractor must be a licensed installer for the county for which the contract is registered. Contractor is responsible for the necessary permit to do the job. The contractor must have a minimum of three year's installation with an owner and provide references for said work.

3.2 EXAMINATION

A. Site Verifications of Conditions

1. Contractor is subject to random examinations by the design firm for verification of conditions on the installation.

3.3 INSTALLATION

A. Equipment and Distribution:

1. Where not provided as part of the electrical work or the data/voice work, the Contractor shall furnish and install necessary conduit, raceways, pull boxes, outlet boxes and cable to provide a complete system as herein specified. All wiring shall be tested for continuity and freedom of all grounds and short-circuits. All outlet boxes shall be as specified for other wiring devices; size as required by equipment manufacturer.

2. Cables shall be installed in pathways, as detailed on the drawings and/or as specified, above non-accessible ceilings, where exposed, and wherever it may be subject to physical damage. Where not provided as part of the electrical work or the data/voice work, the Contractor shall provide a raceway (conduit) from each outlet to above the accessible ceiling. Otherwise, cable shall be installed above accessible suspended tile ceilings and attached to building structure with approved

bridle rings or J hooks, cable is not permitted to rest on ceiling. The cable routes used shall avoid steam lines, power wiring and other utilities that may adversely affect the system's performance or result in damage to the cable. If the routs required place the cable in proximity to these utilities, the cable shall be suitably protected. Under no circumstances shall cable be run in hangers used for pipes or electric conduits nor shall the cable be supported in any way by attachment to these pipes, conduits or ceiling hangers.

3. During the installation work, improper bending, stretching, twisting, kinking, pinching or any other improper handling must not deform the cable. All cable runs shall contain "S" loops or other means to accommodate expansion and contraction. Coaxial cables shall not ben at any point of installation to a radius of less than ten times the diameter of the cable or less than the value recommended by the cable manufacturer. Cable connected to electronic equipment in the system shall be tagged to show its function and the location of its other end. All labels shall be of durable material and securely fastened to the cable.

4. All cables shall be fastened securely with suitable hardware so as to avoid sharp bends and to prevent rubbing against sharp corners and in a manner to prevent injury or physical distortion.

5. All connections shall be made with suitable connectors only at a known point or where otherwise indicated on the drawings to facilitate later system serving. There shall be no splicing of coaxial cables.

6. All coaxial cables shall be installed in a manner to prevent sharp ends and pressure points that may cause the cable to lose its concentricity due to core migration. Particular care shall be taken where bridle rings are used.

7. Wiring for all wall-mounted equipment shall be concealed in raceway (conduit) from outlet to above removable ceilings, unless noted otherwise.

8. Wiring installed above removable ceiling shall be installed on bridle rings. No cables shall be installed on roof or exterior of building.

9. Amplifiers and Multi-Taps properly mounted to painted backboard, neatly arranged in orderly fashion and accurately identified.

10. Equipment cabinet(s) anchored to wall or floor utilizing an approve method.

11. All head-end equipment securely installed within equipment cabinet(s) by screws, bolts, nuts, etc. or by method approved by Design Consultant. All holes intended for equipment mounting used for securing equipment to rack. Provide all exposed hardware in same color and type, preferably matching cabinet finish (i.e. black cabinet-black rack screws).

12. Provide accurate documentation listing all equipment install under this section. This includes; equipment manuals, part numbers, serial numbers, warranties, and location of equipment. If information is found inaccurate during the one-year warranty period. Contractor is required to re-verify all equipment information at no additional cost to client.

13. As-built system design documentation including design assumptions, power budges, system block diagram, and floor plans showing cable routing, antenna locations, and equipment locations.

14. Product data sheets for all electronic equipment, fiber and coaxial cable, splitters, couplers and antennas.

15. Final bill of all materials.

16. Test results of as-built system verifying system meets design requirements including:

17. Results for test showing RSSI and MOS scores measured at discrete points within a 50' or less grid pattern verifying >95% coverage at -95 dBm or greater.

18. RSSI levels at each interior antenna.

19. DBA commissioning documentation including date of commission, actual off-air downlink levels at the donor antenna and BDA, isolation between the donor antenna(s) and the DAS, and BDA gain and AGC settings.

20. Training for up to four personnel on the system not to exceed two hours. Training manuals shall include product data sheets, as-built system documentation, and system testing and commissioning documentation.

3.4 FIELD QUALITY CONTROL

A. Site Tests and Inspections:

1. AHJ shall provide system acceptance based on their criteria.

2. Test every location for signal level:

3. Test all head-end equipment for popery frequency, audio/video carrier levels, and RF level outputs. Adjust all levels per manufacture's recommendations.

4. Perform all testing required for each building during same. Day.

5. Perform tests to all system sunder direct supervision of manufacturer's representatives or accredited agencies for all specified equipment and services.

6. Submit all test results in tabular format with reference to or backed up by equipment/riser diagram that accurately represents installed system.

7. Submit written test report from authorized representative of equipment manufacturer stating that system has been tested and is in working order prior to final inspection by Design Consultant.

8. Upon completion of the installation of the equipment, the video Contractor shall provide to the Design consultant a signed statement from the equipment supplier that the system has been wired, tested, and functions properly according to the specifications.

9. The testing agency making the measurement shall be identified, and the data must be signed and dated by the testing technician.

10. The Contractor shall furnish all equipment and personnel required for the test.

3.5 DEMONSTRATION

A. Owner Training: Provide minimum 8 hours of training for Owner's personnel per building used at Owner's sole discretion and scheduled by Owner to fit Owner needs.

1. Training scheduled by the Owner in blocks of 2-8 hours.

2. Include all per diem, travel costs, etc., in cost of training.

3. Begin training after design consultant deems system physically complete and fully operational. Service time not deemed as training.

4. Include following minimum content in training:

a. General systems overview describing sub-systems and their relationships with each other.

b. Specifics on sub-systems and how to maintain them to ensure reliable operations.

c. Operation of equipment to perform intended tasks, including (but not limited to) remote origination, camera operation, television operations, cable patching, fuse replacement and so forth.

d. Provide written documentation for all training attendees to supplement training (i.e. diagrams, training outlines/highlights, etc.)

END OF SECTION 277700

SECTION 28 05 13 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. UTP cabling.
2. Control-voltage cabling.
3. Control-circuit conductors.
4. Fire alarm wire and cable.
5. Identification products.

1.3 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Cabling administration drawings and printouts.
2. Wiring diagrams to show typical wiring schematics, including the following:

a. Cross-connects.
b. Patch panels.
c. Patch cords.

1.5 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels in Section 061000 "Rough Carpentry."

2.3 CONTROL-VOLTAGE CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Wire & Cable Inc.
2. Belden Inc.
3. General Cable Technologies Corporation.
4. Genesis Cable Products; Honeywell International, Inc.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. One pair, twisted, No. 16 AWG, stranded (19x29) and No. 18 AWG, stranded (19x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

2.4 CONTROL-CIRCUIT CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Wire & Cable Inc.
2. Belden Inc.
3. General Cable Technologies Corporation.
4. Genesis Cable Products; Honeywell International, Inc.

B. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in pathway.

C. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in pathway.

2.5 FIRE ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Wire & Cable Inc.
2. Commscope, Inc.
3. Superior Essex Inc.
4. West Penn Wire

B. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NTRL listed for fire alarm and cable tray installation, plenum rated.

2.6 IDENTIFICATION PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. HellermannTyton.
3. Kroy LLC.

B. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Comply with requirements in Section 260553 "Identification for Electrical Systems."

2.7 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP and optical-fiber cables on reels according to TIA-568-C.1.

C. Factory test UTP cables according to TIA-568-C.2.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for installation of supports for cables.

3.2 WIRING METHOD

A. Install wiring in metal pathways and wireways.

1. Minimum conduit size shall be 3/4 inch (21 mm). Control and data-transmission wiring shall not share conduits with other building wiring systems.
2. Comply with requirements in Section 280528 "Pathways for Electronic Safety and Security."

B. Install cable, concealed in accessible ceilings, walls, and floors when possible.

C. Wiring on Racks and within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM's "Cabling Termination Practices" chapter. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered.
2. Install lacing bars and distribution spools.
3. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer.
4. Install conductors parallel with or at right angles to sides and back of enclosure.
5. Connect conductors associated with intrusion system that are terminated, spliced, or interrupted in any enclosure onto terminal blocks.
6. Mark each terminal according to system's wiring diagrams.
7. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1 and NFPA 70.

B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.

C. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.

D. General Requirements for Cabling:

1. Comply with TIA-568-C.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels. Leave a minimum of 6 inches (150 mm) of slack at outlet terminations and coil loosely into box after termination on outlet fitting.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Maintain minimum cable bending radius during installation and termination of cables.
6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions. Do not exceed manufacturer's rated cable-pulling tension.
9. Riser Cable: Riser cable support intervals shall be in accordance with manufacturer's recommendations.
10. Comply with Section 280544 "Sleeves and Sleeve Seals for Electronic Safety and Security Pathways and Cabling."

3.4 FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method:

1. Cables and pathways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
2. Fire-Rated Cables: Use of two-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is not permitted.
3. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or pathway as signaling line circuits.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color Coding: Color code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm circuit wiring and another for supervisory circuits. Color code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

F. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

G. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 POWER AND CONTROL-CIRCUIT CONDUCTORS

A. 120-V Power Wiring: Install according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.

B. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No. 14 AWG.
2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.

3.6 CONNECTIONS

A. Comply with requirements in Section 281600 "Intrusion Detection" for connecting, terminating, and identifying wires and cables.

B. Comply with requirements in Section 281300 "Access Control" for connecting, terminating, and identifying wires and cables.

C. Comply with requirements in Section 282300 "Video Surveillance" for connecting, terminating, and identifying wires and cables.

D. Comply with requirements in Section 283111 "Digital, Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

3.7 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-C, "Firestopping" Annex A.

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.8 GROUNDING

A. For low-voltage wiring and cabling, comply with requirements in Section 280526 "Grounding and Bonding for Electronic Safety and Security."

3.9 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

      a. Test instruments shall comply with or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

C. End-to-end cabling will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 28 05 13

SECTION 28 05 26 - GROUNDING AND BONDING FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Grounding conductors.
2. Grounding connectors.
3. Grounding busbars.

1.3 DEFINITIONS

A. Signal Ground: The ground reference point designated by manufacturer of the system that is considered to have zero voltage.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube & Conduit; a part of Atkore International.
2. Harger Lightning & Grounding.
3. Panduit Corp.

B. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.

1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.

C. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
   Bonding Cable: 28 kcmils (14.2 sq. mm), 14 strands of No. 17 AWG conductor, and 1/4 inch (6.3 mm) in diameter.
4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
5. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.2 CONNECTORS

A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. Chatsworth Products, Inc.
3. Harger Lightning & Grounding.
4. Panduit Corp.

C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.

1. Electroplated tinned copper, C and H shaped.

D. Busbar Connectors: Cast silicon bronze, solderless exothermic-type mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch (15.8- or 25.4-mm) centers for a two-bolt connection to the busbar.

E. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING BUSBARS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Chatsworth Products, Inc.
2. Harger Lightning & Grounding.

B. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with J-STD-607-A. Predrilling shall be with holes for use with lugs specified in this Section.

1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
2. Rack-Mounted Horizontal Busbar: Designed for mounting in 23-inch (584-mm) equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
3. Rack-Mounted Vertical Busbar: 36 inches (914 mm long, with) copper-plated hardware for attachment to the rack.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with IEEE 1100, "Recommended Practice for Power and Grounding Electronic Equipment."

1. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.
2. Bond shields and drain conductors to ground at only one point in each circuit.

B. Signal Ground:

1. For each system, establish the signal ground and label that location as such.

2. Bond the signal ground to the alternating-current (ac) power system service by connecting to one of the following listed locations, using insulated No. 6 AWG, stranded, Type THHN wire:

   a. Grounding bar in an electrical power panelboard if located in the same room or space as the signal ground.
   b. Telecommunications grounding busbar.

C. Comply with NECA 1.

3.2 APPLICATION

A. Conductors: Install solid conductor for No. 10 AWG and smaller and stranded conductors for No. 8 AWG and larger unless otherwise indicated.

B. Grounding and Bonding Conductors:

1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
2. Install without splices.
3. Support at not more than 36-inch (900-mm) intervals.

3.3 CONNECTIONS

A. Stacking of conductors under a single bolt is not permitted when connecting to busbars.

B. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:

1. Use crimping tool and the die specific to the connector.
2. Pretwist the conductor.
3. Apply an antioxidant compound to all bolted and compression connections.

C. Shielded Cable: Bond the shield of shielded cable to the signal ground. Comply with TIA/EIA-568-B.1 and TIA/EIA-568-B.2 when grounding screened, balanced, twisted-pair cables.

D. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 28 05 26

SECTION 28 05 28 - PATHWAYS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetallic conduits, tubing, and fittings.
3. Optical-fiber-cable pathways and fittings.
4. Surface pathways.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 260533 "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.
2. Section 270528 "Pathways for Communications Systems" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving communications systems.

1.3 ACTION SUBMITTALS

A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For pathway racks, enclosures, cabinets, and equipment racks and their mounting provisions, including those for internal components, from manufacturer.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems; a part of Atkore International.
2. Allied Tube & Conduit; a part of Atkore International.
3. Alpha Wire.
4. Anamet Electrical, Inc.
5. Electri-Flex Company.
6. O-Z/Gedney; a brand of Emerson Industrial Automation.
7. Picoma Industries, Inc.
8. Plasti-Bond.
9. Republic Conduit.

B. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. EMT: Comply with ANSI C80.3 and UL 797.

F. FMC: Comply with UL 1; zinc-coated steel.

G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

a. Material: Steel.
b. Type: Compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.

H. Joint Compound for GRC or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems; a part of Atkore International.
2. Allied Tube & Conduit; a part of Atkore International.
3. Anamet Electrical, Inc.
4. Arnco Corporation.
5. CANTEX INC.
6. CertainTeed Corporation.
7. Condux International, Inc.
8. Electri-Flex Company.
9. Kraloy.

B. General Requirements for Nonmetallic Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

C. ENT: Comply with NEMA TC 13 and UL 1653.

D. RNC: Type EPC-40-PVC complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. Continuous HDPE: Comply with UL 651B.

F. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

G. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire.
2. Arnco Corporation.
3. Endot Industries Inc.
4. IPEX USA LLC.

B. Description: Comply with UL 2024; flexible-type pathway, approved for plenum riser installation unless otherwise indicated.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

2.4 SURFACE PATHWAYS

A. General Requirements for Surface Pathways:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with TIA-569-B.

B. Surface Metal Pathways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. MonoSystems, Inc.
b. Niedax Inc.
c. Panduit Corp.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Wiremold/Legrand
2. Thomas & Betts Coporation; A Member of the ABB Group.
3. Monosystems, Inc.

B. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-B.
2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy aluminum, Type FD, with gasketed cover.

E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

F. Metal Floor Boxes:

1. Material: Cast or sheet metal.
2. Type: Fully adjustable.

3. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Nonmetallic Floor Boxes: Nonadjustable, round.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep) 4 inches by 2-1/8 inches by 2-1/8 inches deep (100 mm by 60 mm by 60 mm deep).

K. Gangable boxes are prohibited.

L. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

N. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND CABLING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Comply with TIA-569-B.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Standard: Comply with SCTE 77.
2. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC" “TELECOMMUNICATIONS”.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of polymer concrete.

1. Standard: Comply with SCTE 77.
2. Color of Frame and Cover: Gray Green.
3. Configuration: Designed for flush burial with open closed integral closed bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC" “TELECOMMUNICATIONS”.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Outdoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried unless otherwise noted.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric-Solenoid, or Motor-Driven Equipment): FMC.
6. Damp or Wet Locations: GRC.
7. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway.
8. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: Riser-type, optical-fiber-cable pathway.
9. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Pathway Size: 3/4-inch (21-mm) trade size. Minimum size for optical-fiber cables is 1 inch (27 mm).

D. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface pathways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

B. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

C. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

D. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications wiring conduits for which only two 90-degree bends are allowed. Support within 12 inches (300 mm) of changes in direction.

E. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

F. Pathways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot (3-m) intervals.
2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
3. Arrange pathways to keep a minimum of 2 inches (50 mm) <Insert dimension> of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

G. Stub-ups to Above Recessed Ceilings:

Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

H. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

I. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

J. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

K. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to conduit assembly to assure a continuous ground path.

L. Spare Pathways: Install pull wires in empty pathways. Cap underground pathways designated as spare above grade alongside pathways in use.

M. Surface Pathways:

1. Install surface pathway for surface electrical outlet boxes only where indicated on Drawings.

N. Pathways for Optical-Fiber and Communications Cable: Install pathways as follows:

1. 1-Inch (27-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).
2. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements.

O. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound.

P. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

Q. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
      Attics: 135 deg F (75 deg C) temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

R. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

S. Mount boxes at heights indicated on Drawings according to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated.

T. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

a. Couple steel conduits to ducts with adapters designed for this purpose.
b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

C. Install handholes with bottom below frost line, refer to details for depth.

D. Field cut openings for conduits according to enclosure manufacturer's written instructions.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electronic Safety and Security Pathways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

END OF SECTION 28 05 28

SECTION 28 05 44 - SLEEVES AND SLEEVE SEALS FOR ELECTRONIC SAFETY AND SECURITY PATHWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.1 SUMMARY

A. Section Includes:

1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:

1. Material: Galvanized-steel sheet.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by the following provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Advance Products & Systems, Inc.
b. CALPICO, Inc.
c. Metraflex Company (The).
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. HOLDRITE.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 3 inches (76.2 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 28 05 44

SECTION 28 16 00 - INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Intrusion detection with communication links to perform monitoring, alarm, and control functions.
2. Integration of other electronic and electrical systems and equipment.

1.3 DEFINITIONS

A. PIR: Passive infrared.

B. RFI: Radio-frequency interference.

C. UPS: Uninterruptible power supply.

D. Control Unit: System component that monitors inputs and controls outputs through various circuits.

E. Master Control Unit: System component that accepts inputs from other control units and may also perform control-unit functions. The unit has limited capacity for the number of protected zones and is installed at an unattended location or at a location where it is not the attendant's primary function to monitor the security system.

F. Monitoring Station: Facility that receives signals and has personnel in attendance at all times to respond to signals. A central station is a monitoring station that is listed.

G. Protected Zone: A protected premises or an area within a protected premise that is provided with means to prevent an unwanted event.

H. Systems Integration: The bringing together of components of several systems containing interacting components to achieve indicated functional operation of combined systems.

1.4 ACTION SUBMITTALS

A. Product Data: Components for sensing, detecting, systems integration, and control, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.

1. Functional Block Diagram: Show single-line interconnections between components including interconnections between components specified in this Section and those furnished under other Sections. Indicate methods used to achieve systems integration. Indicate control, signal, and data communication paths and identify programmable logic controllers, networks, and control interface

devices and media to be used. Describe characteristics of network and other data communication lines.

a. Indicate methods used to achieve systems integration.
b. Indicate control, signal, and data communication paths and identify PLCs, networks, control interface devices, and media to be used.
c. Describe characteristics of network and other data communication lines.
d. Describe methods used to protect against power outages and transient voltages including types and ratings of isolation and surge suppression devices used in data, communication, signal, control, and ac and dc power circuits.

2. Raceway Riser Diagrams: Detail raceway runs required for intrusion detection and for systems integration. Include designation of devices connected by raceway, raceway type and size, and type and size of wire and cable fill for each raceway run.
3. UPS: Sizing calculations.
4. Site and Floor Plans: Indicate final outlet and device locations, routing of raceways, and cables inside and outside the building.
5. Master Control-Unit Console Layout: Show required artwork and device identification.
6. Device Address List: Coordinate with final system programming.
7. System Wiring Diagrams: Include system diagrams unique to Project. Show connections for all devices, components, and auxiliary equipment. Include diagrams for equipment and for system with all terminals and interconnections identified.
8. Details of surge-protection devices and their installation.
9. Sensor detection patterns and adjustment ranges.

C. Design Data: Include method of operation and supervision of each component and each type of circuit. Show sequence of operations for manually and automatically initiated system or equipment inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are unacceptable.

D. Samples for Initial Selection: For units with factory-applied color finishes.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, intrusion detection systems integrator, testing agency.

B. Field quality-control reports.

1. Anchor inspection reports documenting inspections of built-in and cast-in anchors.

C. Product Warranty: Sample of special warranty.

D. Field Test Reports: Test plan and report defining all tests required to ensure that system meets technical, operational, and performance specifications within 60 days of date of Contract award.

E. Evaluation Reports: Examination reports documenting inspections of substrates, areas, and conditions.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For intrusion detection system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Data for each type of product, including features and operating sequences, both automatic and manual.
2. Master control-unit hardware and software data.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Intrusion Detection Devices: Furnish quantity equal to five percent of the number of units of each type installed, but no fewer than one of each type.
2. Fuses: Three of each kind and size.
3. Tool Kit: Provide six sets of tools for use with security fasteners, each packaged in a compartmented kit configured for easy handling and storage.
4. Security Fasteners: Furnish no fewer than 1 box for every 50 boxes or fraction thereof, of each type and size of security fastener installed.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. The intrusion installer must have an authorized DMP Security partner certification.

B. Intrusion Detection Systems Integrator Qualifications:

1. The Contractor shall provide the services of the school district’s S2 support integrator to provide, integrate and program access control system into the DMP system

C. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Control Units, Devices, and Communications with Monitoring Station: Listed and labeled by a qualified testing agency for compliance with SIA CP-01.

F. FM Global Compliance: FM-Approved and -labeled intrusion detection devices and equipment.

G. Comply with NFPA 70.

1.9 PROJECT CONDITIONS

A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Altitude: Sea level to 4000 feet.
2. Master Control Unit: Rated for continuous operation in an ambient of 60 to 85 deg F and a relative humidity of 20 to 80 percent, noncondensing.
3. Interior, Controlled Environment: System components, except master control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambients of 36 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of intrusion detection devices and equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FUNCTIONAL DESCRIPTION OF SYSTEM

A. Provide a DMP intrusion panel with IP Ethernet Interface.

B. The DMP panel will provide door status information to the panel.

C. Provide event programming and notification of door status, alarm and trouble signals.

D. Supervision: System components shall be continuously monitored for normal, alarm, Supervisory, and trouble conditions. Indicate deviations from normal conditions at any location in system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.

1. Alarm Signal: Display at master control unit and actuate audible and visual alarm devices.
2. Trouble Condition Signal: Distinct from other signals, indicating that system is not fully functional. Trouble signal shall indicate system problems such as battery failure, open or shorted transmission line conductors, or control-unit failure.
3. Supervisory Condition Signal: Distinct from other signals, indicating an abnormal condition as specified for the particular device or control unit.

E. System Control: Master control unit shall directly monitor intrusion detection units and connecting wiring.

F. System shall automatically reboot program without error or loss of status or alarm data after any system disturbance.

G. Operator Commands:

1. Help with System Operation: Display all commands available to operator. Help command, followed by a specific command, shall produce a short explanation of the purpose, use, and system reaction to that command.
2. Acknowledge Alarm: To indicate that alarm message has been observed by operator.
3. Place Protected Zone in Access: Disable all intrusion-alarm circuits of a specific protected zone. Tamper circuits may not be disabled by operator.
4. Place Protected Zone in Secure: Activate all intrusion-alarm circuits of a protected zone.
5. Protected Zone Test: Initiate operational test of a specific protected zone.
6. System Test: Initiate system-wide operational test.
7. Print reports.

H. Timed Control at Master Control Unit: Allow automatically timed "secure" and "access" functions of selected protected zones.

I. Automatic Control of Related Systems: Alarm or supervisory signals from certain intrusion detection devices control the following functions in related systems:

1. Switch selected lights.
2. Shift elevator control to a different mode.
3. Open a signal path between certain intercommunication stations.

J. Printed Record of Events: Print a record of alarm, supervisory, and trouble events on system printer. Sort and report by protected zone, device, and function. When master control unit receives a signal, print a report of alarm, supervisory, or trouble condition. Report type of signal (alarm, supervisory, or trouble), protected zone description, date, and time of occurrence. Differentiate alarm signals from other indications. When system is reset, report reset event with the same information concerning device, location, date, and time.

Commands shall initiate the reporting of a list of current alarm, supervisory, and trouble conditions in system or a log of past events.

K. Response Time: Two seconds between actuation of any alarm and its indication at master control unit.

L. Circuit Supervision: Supervise all signal and data transmission lines, links with other systems, and sensors from master control unit. Indicate circuit and detection device faults with both protected zone and trouble signals, sound a distinctive audible tone, and illuminate an LED. Maximum permissible elapsed time between occurrence of a trouble condition and indication at master control unit is 20 seconds. Initiate an alarm in response to opening, closing, shorting, or grounding of a signal or data transmission line.

M. Programmed Secure-Access Control: System shall be programmable to automatically change status of various combinations of protected zones between secure and access conditions at scheduled times. Status changes may be preset for repetitive, daily, and weekly; specially scheduled operations may be preset up to a year in advance. Manual secure-access control stations shall override programmed settings.

N. Manual Secure-Access Control: Coded entries at manual stations shall change status of associated protected zone between secure and access conditions.

2.2 SYSTEM COMPONENT REQUIREMENTS

A. Compatibility: Detection devices and their communication features, connecting wiring, and master control unit shall be selected and configured with accessories for full compatibility with the following equipment:
   a. Cellular Dialer

B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.

   1. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."
   2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Listed and labeled by a qualified testing agency for compliance with NFPA 731.

C. Intrusion Detection Units: Listed and labeled by a qualified testing agency for compliance with UL 639.

D. Interference Protection: Components shall be unaffected by radiated RFI and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz and conducted interference signals up to 0.25-V rms injected into power supply lines at 10 to 10,000 MHz.

E. Tamper Protection: Tamper switches on detection devices, control units, annunciators, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled and when entering conductors are cut or disconnected. Master control-unit alarm display shall identify tamper alarms and indicate locations.

F. Self-Testing Devices: Automatically test themselves periodically, but not less than once per hour, to verify normal device functioning and alarm initiation capability. Devices transmit test failure to master control unit.

G. Antimasking Devices: Automatically check operation continuously or at intervals of a minute or less, and use signal-processing logic to detect blocking, masking, jamming, tampering, or other operational dysfunction. Devices transmit detection of operational dysfunction to master control unit as an alarm signal.

H. Addressable Devices: Transmitter and receivers shall communicate unique device identification and status reports to master control unit.

I. Remote-Controlled Devices: Individually and remotely adjustable for sensitivity and individually monitored at master control unit for calibration, sensitivity, and alarm condition.

2.3 ENCLOSURES

A. Interior Sensors: Enclosures that protect against dust, falling dirt, and dripping noncorrosive liquids.

B. Interior Electronics: NEMA 250, Type 12.

C. Exterior Electronics: NEMA 250, Type 4X, stainless steel.

D. Corrosion Resistant: NEMA 250, Type 4X, stainless steel.

E. Screw Covers: Where enclosures are readily accessible, secure with security fasteners of type appropriate for enclosure.

2.4 COMPONENTS

A. Provide the following DMP components and devices as shown on the drawings:
1. Provide (1) 142 ZONES, DIALER/NETWORK, 350 LG GRAY ENCLOSURE
2. Provide (1) AT&T LTE CELLULAR COMMUNICATOR W/ 381-2 CABLE
3. Provide (1) 4-WIRE HARNESS, DUAL CONNECTORS
4. Provide SINGLE PT ZONE EXPANDER, ROTARY SWITCH ADDRESSING as required.
5. Provide OPTEX 70'X 70' Wall Mounted PIR as shown on the drawings.
6. Provide OPTEX 360 DEGREE PIR as shown on the drawings.
7. Provide (1) Keypad as shown on the drawings.

2.5 DOOR AND WINDOW SWITCHES

A. Description: Balanced-magnetic switch, complying with UL 634, installed on frame with integral overcurrent device to limit current to 80 percent of switch capacity. Bias magnet and minimum of two encapsulated reed switches shall resist compromise from introduction of foreign magnetic fields.

B. Flush-Mounted Switches: Unobtrusive and flush with surface of door and window frame.

C. Overhead Door Switch: Balanced-magnetic type, listed for outdoor locations, and having door-mounted magnet and floor-mounted switch unit.

D. Remote Test: Simulate movement of actuating magnet from master control unit.

2.6 MASTER CONTROL UNIT

A. Description: Supervise sensors and detection subsystems and their connecting communication links, status control (secure or access) of sensors and detector subsystems, activation of alarms and supervisory and trouble signals, and other indicated functions.

1. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
2. Include a real-time clock for time annotation of events on the event recorder and printer.
3. Addressable initiation devices that communicate device identity and status.
4. Control circuits for operation of mechanical equipment in response to an alarm.

B. Construction: Freestanding equipment rack, modular, with separate and independent alarm and supervisory system modules. Alarm-initiating protected zone boards shall be plug-in cards. Arrangements that require removal of field wiring for module replacement are unacceptable.

C. Comply with UL 609.

D. Console Controls and Displays: Arranged for interface between human operator at master control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
   1. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
   2. Control-Unit Network: Automatic communication of alarm, status changes, commands, and other communications required for system operation. Communication shall return to normal after partial or total network interruption such as power loss or transient event. Total or partial signaling network failures shall identify the failure and record the failure at the annunciator display and at the system printer.
   3. Field Device Network: Communicate between the control unit and field devices of the system. Communications shall consist of alarm, network status, and status and control of field-mounted processors. Each field-mounted device shall be interrogated during each interrogation cycle.
   4. Operator Controls: Manual switches and push-to-test buttons that do not require a key to operate. Prevent resetting of alarm, supervisory, or trouble signals while alarm or trouble condition persists. Include the following:

      a. Acknowledge alarm.
      b. Silence alarm.
      c. System reset.
      d. LED test.

   5. Timing Unit: Solid state, programmable, 365 days.
   6. Confirmation: Relays, contactors, and other control devices shall have auxiliary contacts that provide confirmation signals to system for their on or off status. Software shall interpret such signals, display equipment status, and initiate failure signals.
   7. Alarm Indication: Audible signal sounds and an LED lights at master control unit identifying the protected zone originating the alarm. Annunciator panel displays a common alarm light and sounds an audible tone.
   8. Alarm activation sounds a bell or siren and strobe.

E. Protected Zones: Quantity of alarm and supervisory zones as indicated, with capacity for expanding number of protected zones by a minimum of 25 percent.

F. Power Supply Circuits: Master control units shall provide power for remote power-consuming detection devices. Circuit capacity shall be adequate for at least a 25 percent increase in load.

G. UPS: Comply with Section 263353 "Static Uninterruptible Power Supply." UPS shall be sized to provide a minimum of six hours of master control-unit operation.

H. Cabinet: Lockable, steel enclosure arranged so operations required for testing, normal operation, and maintenance are performed from front of enclosure. If more than a single cabinet is required to form a complete control unit, provide exactly matching modular enclosures. Accommodate all components and allow ample gutter space for field wiring. Identify each enclosure by an engraved, laminated, phenolic-resin nameplate. Lettering on enclosure nameplate shall not be less than 1 inch high. Identify, with permanent labels, individual components and modules within cabinets.

I. Transmission to Monitoring Station: A communications device to automatically transmit alarm, supervisory, and trouble signals to the monitoring station, operating over a standard voice grade telephone leased line. Comply with UL 1635.

J. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

2.7 SECURITY FASTENERS

A. Operable only by tools produced for use on specific type of fastener by fastener manufacturer or other licensed fabricator. Drive system type, head style, material, and protective coating as required for assembly, installation, and strength.

B. Drive System Types: Pinned Torx-Plus

C. Socket Flat Countersunk Head Fasteners:

1. Heat-treated alloy steel, ASTM F 835.
2. Stainless steel, ASTM F 879, Group 1 CW.

D. Socket Button Head Fasteners:

1. Heat-treated alloy steel, ASTM F 835.
2. Stainless steel, ASTM F 879, Group 1 CW.

E. Socket Head Cap Fasteners:

1. Heat-treated alloy steel, ASTM A 574.
2. Stainless steel, ASTM F 837, Group 1 CW.

F. Protective Coatings for Heat-Treated Alloy Steel:

1. Zinc chromate, ASTM F 1135, Grade 3 or Grade 4, for exterior applications and interior applications where indicated.
2. Zinc phosphate with oil, ASTM F 1137, Grade I, or black oxide unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of intrusion detection.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of intrusion detection connections before intrusion detection installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of intrusion detection.

D. Inspect built-in and cast-in anchor installations, before installing intrusion detection, to verify that anchor installations comply with requirements. Prepare inspection reports.

1. Remove and replace anchors where inspections indicate that they do not comply with requirements. Reinspect after repairs or replacements are made.
2. Perform additional inspections to determine compliance of replaced or additional anchor installations. Prepare inspection reports.

E. For material whose orientation is critical for its performance as a ballistic barrier, verify installation orientation.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SYSTEM INTEGRATION

A. Integrate intrusion detection system with the following systems and equipment:

1. Electronic door hardware.
2. Elevators.
3. Access control.
4. Fire-alarm system.
5. Perimeter security system.
6. Video surveillance.

3.3 SYSTEM INSTALLATION

A. Comply with UL 681 and NFPA 731.

B. Equipment Mounting: Install master control unit on finished floor with tops of cabinets not more than 72 inches above the finished floor.

C. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.

D. Connecting to Existing Equipment: Verify that existing perimeter security system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the Supervising Station.
3. Expand, modify, and supplement existing equipment as necessary to extend existing functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

E. Security Fasteners: Where accessible to inmates, install intrusion detection components using security fasteners with head style appropriate for fabrication requirements, strength, and finish of adjacent materials except that a maximum of two different sets of tools shall be required to operate security fasteners for Project. Provide stainless-steel security fasteners in stainless-steel materials.

3.4 WIRING INSTALLATION

A. Wiring Method: Install wiring in metal raceways according to Section 260533 "Raceways and Boxes for Electrical Systems." Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be 1/2 inch. Control and data transmission wiring shall not share conduit with other building wiring systems.

B. Wiring Method: Cable, concealed in accessible ceilings, walls, and floors when possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Wires and Cables:

1. Conductors: Size as recommended in writing by system manufacturer unless otherwise indicated.
2. 120-V Power Wiring: Install according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.

3. Control and Signal Transmission Conductors: Install unshielded, twisted-pair cable unless otherwise indicated or if manufacturer recommends shielded cable, according to Section 280513 "Conductors and Cables for Electronic Safety and Security."
4. Data and Television Signal Transmission Cables: Install according to Section 280513 "Conductors and Cables for Electronic Safety and Security."

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

F. Install power supplies and other auxiliary components for detection devices at control units unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.

G. Identify components with engraved, laminated-plastic or metal nameplate for master control unit and each terminal cabinet, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with identification requirements in Section 260553 "Identification for Electrical Systems."

B. Install instructions frame in a location visible from master control unit.

3.6 GROUNDING

A. Ground the master control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to master control unit.

B. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

C. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding. Provide 5-ohm ground. Measure, record, and report ground resistance.

D. Install grounding electrodes of type, size, location, and quantity indicated. Comply with installation requirements in Section 280526 "Grounding and Bonding for Electronic Safety and Security."

3.7 FIELD QUALITY CONTROL

A. Pretesting: After installation, align, adjust, and balance system and perform complete pretesting to determine compliance of system with requirements in the Contract Documents. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.

1. Report of Pretesting: After pretesting is complete, provide a letter certifying that installation is complete and fully operable; include names and titles of witnesses to preliminary tests.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

E. Tests and Inspections: Comply with provisions in NFPA 731, Ch. 9, "Testing and Inspections."

1. Inspection: Verify that units and controls are properly labeled, and interconnecting wires and terminals are identified.
2. Test Methods: Intrusion detection systems and other systems and equipment that are associated with detection and accessory equipment shall be tested according to Table "Test Methods" and Table "Test Methods of Initiating Devices."

F. Documentation: Comply with provisions in NFPA 731, Ch. 4, "Documentation."

G. Tag all equipment, stations, and other components for which tests have been satisfactorily completed.

3.8 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other-than-normal occupancy hours for this purpose. Visits for this purpose shall be in addition to any required by warranty.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the intrusion detection system. Comply with documentation provisions in NFPA 731, Ch. 4, "Documentation and User Training."

END OF SECTION 28.1600

SECTION 28 31 11 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Magnetic door holders.
7. Remote annunciator.
8. Addressable interface device.
9. Digital alarm communicator transmitter.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.

    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm.
    c. Locate detectors according to manufacturer's written recommendations.

12. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:

a. Trained and certified by manufacturer in fire-alarm system design.
b. NICET-certified, fire-alarm technician; Level III minimum.
c. Licensed or certified by authorities having jurisdiction.

D. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.

C. Field quality-control reports.

D. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to building Owner’s Representative at the time of system acceptance:

a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between all devices and equipment.
d. Riser diagram.
e. Record copy of site-specific software.
f. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

1) Equipment tested.
2) Frequency of testing of installed components.
3) Frequency of inspection of installed components.
4) Requirements and recommendations related to results of maintenance.
5) Manufacturer's user training manuals.

g. Manufacturer's required maintenance related to system warranty requirements.
h. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.
i. Point-to-point diagrams of the entire Life Safety System as installed. This shall include all connected Smoke Detectors and addressable field modules. All drawings shall be provided

in CAD and supplied in standard DXF format. Vellum plots of each sheet shall also be provided. A system generated point-to-point diagram is required to ensure accuracy.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.

C. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

D. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.7 WARRANTY

A. Warranty: Warranty all materials, installation and workmanship for three (2) years from date of acceptance, unless otherwise specified. A copy of the manufacturers' warranty shall be provided with close-out documentation and included with the operation and installation manuals.

1. Manufacturer shall guarantee the system equipment for a period of two (2) years from date of final acceptance of the system.
2. The Contractor shall guarantee all wiring and raceways to be free from inherent mechanical or electrical defects for two (2) years from date of final acceptance of the system.
3. Upon completion of the installation of fire alarm system equipment, the Contractor shall provide to the architect a signed written statement, substantially in form as follows: "The undersigned, having engaged as the Contractor on the Project confirms that the fire alarm system equipment was installed in accordance with the wiring diagrams, instructions and directions provided to us by the manufacturer."

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Addressable Fire Alarm System: Non-coded, addressable microprocessor-based fire alarm system with initiating devices, notification appliances, monitoring and control devices, and connection to an approved Supervising Station. The Notification Appliances on this project shall be Horns & Horn Strobes. The use of Horn and Horn Strobes shall not be permitted on this project. It is the responsibility of the system integrator to furnish the appropriate amount of signal extender and amplifier panels needed to support all of the notification appliance shown on the project drawings.

B. Manufacturers: Subject to compliance with requirements, provide only products listed. Basis of design is Silent Knight:

1. Silent Knight Farenhyt,
2. Notifier

3. Simplex

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. The system shall automatically display on the control panel Liquid Crystal Display the first event of the highest priority by type. The priorities and types shall be alarm, supervisory, trouble, and monitor.

1. The system shall have a Queue operation and shall not require event acknowledgment by the system operator. The system shall have a labeled color-coded indicator for each type of event; alarm - red, supervisory - yellow, trouble - yellow, monitor - yellow. When an unseen event exists for a given type, the indicator shall be lit.
2. For each event, the display shall include the current time, the total number of events, the type of event, the time the event occurred and up to a 42-character custom user description.
3. The user shall be able to review each event by simply selecting scrolling keys (up-down) for each event type
4. New alarm, supervisory, or trouble events shall sound a silencing audible signal at the control panel.

B. Operation of any alarm initiating device shall automatically:

1. Update the control/display as described above (A.1.)
2. Audible devices shall have the ability to be silenced.
3. Activate all strobe appliances throughout the facility. ALL STROBE APPLIANCES SHALL BE SYNCHRONIZED WITH EACH OTHER IN ANY LOCATION WITH TWO OR MORE DEVICES IN A COMMON FIELD OF VIEW. Visual devices shall be non-silenced unless the system is successfully reset.
4. Operate control relay contacts to shutdown all HVAC units serving the floor of alarm initiation.
5. Operate control relay contacts to return all elevators that serve the floor of alarm initiation to the ground floor. If the alarm originates from the ground floor, operate control circuits contacts to return all elevators to the floor above or to a level as directed by the local fire department.
6. Operate control relay contacts to release all magnetically held smoke doors throughout the building.
7. Visually annunciate the individual point of alarm on all remote annunciator panels. The visual indication shall remain on until the alarm condition is reset to normal.
8. Transmit an alarm condition, via the integral central station communicator, to central station/Local Fire Department (as required by the AHJ).

C. Elevator smoke and heat detector sequences shall comply with the ANSI A17.1 requirements for main/alternate floor recalls, and shunt trip activations.

D. Activation of a sprinkler supervisory initiating device shall:

1. Update the control/display as described above (A.1.)
2. Transmit a supervisory condition, via the integral central station communicator, to central station/Local Fire Department (as required by the AHJ).
3. Visually annunciate the individual point of alarm on all remote annunciator panels. The visual indication shall remain on until the alarm condition is reset to normal.

E. The entire fire alarm system wiring shall be electrically supervised to automatically detect and report trouble conditions to the fire alarm control panel. Any opens, grounds or disarrangement of system wiring and shorts across alarm signaling wiring shall automatically:

1. Update the control/display as described above (A.1.)
2. Transmit a trouble condition, via the integral central station communicator, to central station/Local Fire Department (as required by the AHJ).
3. Visually and audibly annunciate a general trouble condition, on the remote annunciator panels. The visual indication shall remain on until the trouble condition is repaired.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.4 FIRE-ALARM CONTROL UNIT

A. Basis of design is a Silent Knight Farenhyt and shall incorporate all control electronics, relays, and necessary modules and components in a surface mounted cabinet. The operating controls and zone/supervisory indicators shall be located behind locked door with viewing window. All control modules shall be labeled, and all zone locations shall be identified. The cabinet shall be steel, with a gray finish. The assembly shall contain a base panel, system power supply and battery charger with optional modules suitable to meet the requirements of these specifications.

B. System circuits shall be configured as follows: Addressable analog loops Class B; Notification Appliance Circuits Class B.

C. Single stage operation.

D. The system shall be supervised, site programmable, and of modular design with expansion modules to serve up to 192 detectors and 188 remote modules, and four notification appliance circuits (NACs) convertible to power risers to serve remote multiple NAC modules for zoned signal applications.

E. The system shall store all basic system functionality and job specific data in non-volatile memory. The system shall survive a complete power failure intact.

F. The system shall have built-in automatic system programming to automatically address and map all system devices and provide a minimum default single stage alarm system operation with support of alarm silence, trouble silence, drill, lamp test, and reset common controls.

G. The system shall allow down loading of a job specific custom program created by system application software. It shall support programming of any input point to any output point. The system shall support the use of Bar Code readers to assist custom programming functions. It shall allow authorized customization of fundamental system operations using initiating events to start actions, timers, sequences and logical algorithms.

H. The system shall support distributed processor intelligent detectors with the following operational attributes; integral multiple differential sensors, automatic device mapping, electronic addressing, environmental compensation, pre-alarm, dirty detector identification, automatic day/night sensitivity adjustment, dual normal/alarm LEDs, relay bases, and isolator bases.

I. The system shall use full digital communications to supervise all addressable loop devices for placement, correct location, and operation. It shall allow swapping of "same type" devices without the need of addressing and impose the "location" parameters on replacement device. It shall initiate and maintain a trouble if a device is added to a loop and clear the trouble when the new device is mapped and defined into the system.

J. The system shall have a UL Listed Detector Sensitivity test feature, which will be a function of the smoke detectors and performed automatically every 4 hours.

K. The system shall support 100% of all remote devices in alarm and provide support for a 100% compliment of detector isolator bases.

L. All panel modules shall be supervised for placement and return trouble if damaged or removed.

M. The system shall have a CPU watchdog circuit to initiate trouble should the CPU fail.

N. The system evacuation signal rate shall be continuous, or March time at 120 PPM.

O. Provide a signal silence inhibit feature set to enter integer time between 0-99 minutes and an automatic signal silence timer set to enter integer time between 0-99 minutes. Audible notification appliances shall be affected by signal silence features. Visual signal appliance shall not be affected by signal silence features.

P. The system program shall meet the requirements of this project, current codes and standards, and satisfy the Office of Life Safety.

Q. Passwords shall protect any changes to system operations.

R. The power supply shall be a high efficiency switch mode type with line monitoring to automatically switch to batteries for power failure or brown out conditions. The automatic battery charger shall have low battery discharge protection. The power supply shall provide internal power and 24 Vdc at 4A continuous for notification appliance circuits. The power supply shall be capable of providing 10A to output circuits for a maximum period of 50 ms. Auxiliary power shall be 24 Vdc at 500 mA. All outputs shall be power limited. The battery shall be sized to support the system for [24 or 4] hours of supervisory and trouble signal current plus general alarm for 5 minutes.

S. The LCD Display Module shall be of membrane style construction with a 4 line by 20 character Liquid Crystal Display. The LCD shall use supertwist technology and backlighting for high contrast visual clarity. In the normal mode display the time, the total number of active events and the total number of disable points. In the alarm mode display the total number of events and the type of event on display. Reserve 40 characters of display space for user custom messages. The module shall have visual indicators for the following common control functions; AC Power, alarm, supervisory, monitor, trouble, disable, ground fault, cpu fail, and test. There shall be common control keys and visual indicators for; reset, alarm silence, trouble silence, drill, and one custom programmable key/indicator. Provide four pairs of display control keys for selection of event display by type (alarm, supervisory, monitor and trouble) and forward / backward scrolling through event listings. The operation of these keys shall be integrated with the related common control indicators to flash the indicators when undisplayed events are available for display and turn on steady when all events have been displayed. Allow the first event of the highest priority to capture the LCD for display so that arriving fire fighters can view the first alarm event "hands free". Provide system function keys; status, reports, enable, disable, activate, restore, program, and test. The module shall have a numeric keypad, zero through nine with delete and enter keys.

T. The Main Controller Module shall control and monitor all local or remote peripherals. It shall support the LCD Display Module, power supply, remote LCD and zone display annunciators, strip and carriage printers, and support communication interface standard protocol (CSI) devices such as color computer annunciators and color graphic displays. The RS-485 port shall be capable of supporting up to 32 remote annunciators. The MCM shall provide one loop controller circuit, two notification appliance circuits, and common form 'C' contacts for alarm, supervisory, and trouble. Contact ratings shall be 24Vdc at 1A.

2.5 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. It shall be possible to address each Signature Series fire alarm pull station without the use of DIP or rotary switches. Devices using DIP switches for addressing shall not be acceptable. The manual stations shall have a minimum of 2 diagnostic LEDs mounted on their integral, factory assembled single or two stage input module. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The station shall be capable of storing up to 24 diagnostic codes that can be retrieved for troubleshooting assistance. Input circuit wiring shall be supervised for open and ground faults. The fire alarm pull station shall be suitable for operation in the following environment: Temperature: 32°F to 120°F (0°C to 49°C), Humidity: 0-93% RH, non-condensing.

1. Manual Fire Alarm Stations: Provide intelligent single action, single stage fire alarm stations. The fire alarm station shall be of metal construction with an internal toggle switch. Provide a locked test feature. Finish the station in red with silver “PULL IN CASE OF FIRE” English lettering. The manual station shall be suitable for mounting on North American 2 ½” (64mm) deep 1-gang boxes and 1 ½” (38mm) deep 4” square boxes with 1-gang covers.

2. On all manual pull stations, provide and install a clear cover, hinged protective tamper shield UL listed for manual pull stations. When fully open, the cover shall permit full access to the operating handle of the pull station. When the cover is lifted, an internal local audible alarm shall sound. Alarm shall be powered by the fire alarm system or an internal battery suitable for replacement on an annual or as needed basis without affecting the operation of the fire alarm system.

    a. Manufacturer: STI Stopper II or approved equal.

2.6 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Provide intelligent photoelectric smoke detectors. The analog photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. Systems using central intelligence for alarm decisions shall not be acceptable. The detector shall continually monitor any changes in sensitivity due to the environmental effects of dirt, smoke, temperature, aging and humidity. The information shall be stored in the integral processor and transferred to the analog loop controller for retrieval using a laptop PC. The photo detector shall be rated for ceiling installation at a minimum of 30 ft (9.1m) centers and be suitable for wall mount applications. The photoelectric smoke detector shall be suitable for direct insertion into air ducts up to 3 ft (0.91m) high and 3 ft (0.91m) wide with air velocities up to 5,000 ft/min. (0-25.39 m/sec) without requiring specific duct detector housings or supply tubes.

    a. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5%. The photo detector shall be suitable for operation in the following environment:

        1) Temperature: 32ºF to 120ºF (0ºC to 49ºC)
        2) Humidity: 0-93% RH, non-condensing
        3) Elevation: no limit

2. Provide standard detector mounting bases suitable for mounting on North American 1-gang, 31/2” or 4” octagon box and 4” square box. The base shall, contain no electronics, support all Signature Series detector types and have the following minimum requirements:

    a. Removal of the respective detector shall not affect communications with other detectors.
    b. Terminal connections shall be made on the room side of the base. Bases which must be removed to gain access to the terminals shall not be acceptable.
    c. The base shall be capable of supporting one (1) Signature Series SIGA-LED Remote Alarm LED Indicator. Provide remote LED alarm indicators where shown on the plans..

B. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Duct Detector Housing: Low profile intelligent addressable DUCT smoke detector as indicated on the project plans. Provide for variations in duct air velocity between 100 and 4,000 feet per minute and include a wide sensitivity range of .79 to 2.46%/ft. Obscuration. Include one Form-C shut down relay rated 2.0 amps @ 30 Vdc and also include slave high contact relays if required. Provide an air exhaust tube and an air sampling inlet tube that extends into the duct air stream up to ten feet. The addressable DUCT housing shall be suitable for extreme environments, including a temperature range of –20 to 158 degrees F (-29 to 70 degrees Celsius) and offer a harsh environment gasket option. Provide Remote Alarm LED Indicators and/or remote test station model as indicated on the project plans.

2.7 CARBON MONOXIDE DETECTORS

A. General: Carbon monoxide detector listed for connection to fire-alarm system.

1. Addressable Carbon Monoxide (CO) Detector, with audible sounder base. Provide intelligent addressable Carbon Monoxide Detector with Temporal 4 Audible Base. The CO detection element shall indicate a trouble condition at the FACP signaling end of life and the CO element of the detector shall be field replaceable. It shall be programmed at the main control panel as a supervisory indication and transmit a separate supervisory signal to the central station. The CO detector shall be UL 2075 listed.

2.8 MONITOR MODULES

A. General Requirements for Monitor Modules:

1. Single Input Module, (Waterflow Detectors, Tamper Switches etc.): Provide intelligent single input modules. The Single Input Module shall provide one (1) supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers. The single input module shall support the following circuit types:

   a. Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.),
   b. Normally-Open Alarm Delayed Latching (Waterflow Switches),
   c. Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.),
   d. Normally-Open Active Latching (Supervisory, Tamper Switches).

2. Dual Input Module: Provide intelligent dual input modules. The Dual Input Module shall provide two (2) supervised Class B input circuits each capable of a minimum of 4 personalities, each with a distinct operation. The module shall be suitable for mounting on North American 2 ½" deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers. The dual input module shall support the following circuit types:

   a. Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.),
   b. Normally-Open Alarm Delayed Latching (Waterflow Switches),
   c. Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.),
   d. Normally-Open Active Latching (Supervisory, Tamper Switches).

3. Single Input Signal Module: Provide intelligent single input signal modules SIGA-CC1. The Single Input (Single Riser Select) Signal Module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation. When selected as a telephone power selector, the module shall be capable of generating its own "ring tone". The module shall be suitable for mounting on North American 2 ½" (64mm) deep 2-gang boxes and 1 ½" (38mm) deep 4" square boxes with 2-gang covers, or European 100mm square boxes. The single input signal module shall support the following operations:

   a. Audible/Visible Signal Power Selector (Polarized 24 Vdc @ 2A).

4. Dual Input Signal Module: Provide intelligent dual input signal modules. The Dual Input (Dual Riser Select) Signal Module shall provide a means to selectively connect one of two (2) signaling circuit power risers to one (1) supervised output circuit. The module shall be suitable for mounting on North American 2- 1/2" (64mm) deep 2-gang boxes and 1- 1/2" (38mm) deep 4" square boxes with 2-gang covers, or European 100mm square boxes. The dual input signal module shall support the following operation:

   a. Audible/Visible Signal Power Selector (Polarized 24 Vdc @ 2A, 25 Vrms @ 50w or 70 Vrms @ 35w of Audio)

5. Control Relay Module: Provide intelligent control relay modules SIGA-CR. The Control Relay Module shall provide one form "R" dry relay contact rated at 2 amps @ 24 Vdc to control external appliances or equipment shutdown. The control relay shall be rated for pilot duty and releasing systems. The position of the relay contact shall be confirmed by the system firmware. The control relay module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" deep 4" square boxes with 1-gang covers.
6. Audible Detector Mounting Base. The sounder base shall be capable of two tones, Temporal 3 for a fire condition and Temporal 4 for a Carbon monoxide condition. The tones shall be fully

programmable and also synchronize the sound with other sounder bases. The system shall be UL2017 listed for dual signaling for this purpose.

7. Monitor Module: Provide intelligent monitor modules. The Monitor Module shall be factory set to support one (1) supervised Class B Normally-Open Active Non-Latching Monitor circuit. The monitor module shall be suitable for mounting on North American 2- 1/2" (64mm) deep 1-gang boxes and 1- 1/2" (38mm) deep 4" square boxes with 1-gang.
8. Universial Class A/B Module: Provide intelligent Class A/B modules. The Universal Class A/B Module shall be capable of a minimum of fifteen (15) distinct operations. The module shall be suitable for mounting on North American 2 1/2" (64mm) deep 2-gang boxes and 1 1/2" (38mm) deep 4" square boxes with 2-gang covers, or European 100mm square boxes. The universal class A/B module shall support the following circuit types:

    a. Two (2) supervised Class B Normally-Open Alarm Latching.
    b. Two (2) supervised Class B Normally-Open Alarm Delayed Latching.
    c. Two (2) supervised Class B Normally-Open Active Non-Latching.
    d. Two (2) supervised Class B Normally-Open Active Latching.
    e. One (1) form "C" dry relay contact rated at 2 amps @ 24 Vdc.
    f. One (1) supervised Class A Normally-Open Alarm Latching.
    g. One (1) supervised Class A Normally-Open Alarm Delayed Latching.
    h. One (1) supervised Class A Normally-Open Active Non-Latching.
    i. One (1) supervised Class A Normally-Open Active Latching.
    j. One (1) supervised Class A 2-wire Smoke Alarm Non-Verified.
    k. One (1) supervised Class B 2-wire Smoke Alarm Non-Verified.
    l. One (1) supervised Class A 2-wire Smoke Alarm Verified
    m. One (1) supervised Class B 2-wire Smoke Alarm Verified
    n. One (1) supervised Class A Signal Circuit, 24Vdc @ 2A.
    o. One (1) supervised Class B Signal Circuit, 24Vdc @ 2A

2.9 WATERFLOW/TAMPER MODULE

A. Waterflow/Tamper Module: The Waterflow/Tamper Module shall be factory set to support two (2) supervised Class B input circuits. Channel A shall support a Normally-Open Alarm Delayed Latching Waterflow Switch circuit. Channel B shall support a Normally-Open Active Latching Tamper Switch. The waterflow/tamper module shall be suitable for mounting on North American 2 1/2" (64mm) deep 1-gang boxes and 1 1/2" (38mm) deep 4" square boxes with 1-gang covers.

2.10 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections. Devices shall be 100% compatible with control equipment.

B. Strobes, System Sensor L Series: Provide L Series SGWL low profile wall mounted strobes at the locations shown on the drawings. Provide L Series SCWL series low profile ceiling mounted Strobes shall provide synchronized flash outputs. Strobe output shall be field selectable as indicated on the drawings in one of the following intensity levels; 15/75, 15cd, 30cd, 75cd or 110cd*. Low profile strobes shall mount in a North American 1-gang box or surface mounted on a matching back box provided by the manufacturer, as directed in the field.

C. Horn Strobes, L-Series: Provide low profile wall mounted horn strobes at the locations shown on the drawings. Provide low profile ceiling mounted horn strobes shall provide synchronized flash outputs. Horn strobe output shall be field selectable as indicated on the drawings in one of the following intensity levels; 15/75, 15cd, 30cd, 75cd or 110cd*. Low profile strobes shall mount in a North American 1-gang box or surface mounted on a matching back box provided by the manufacturer, as directed in the field.

2.11 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.

1. Electromagnets: Require no more than 3 W to develop 25-lbf (111-N) holding force.
2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
3. Rating: 24-V ac or dc.

B. Material and Finish: Match door hardware.

2.12 DIGITAL COMMUNICATOR

A. The Multi-Point Digital Alarm Communicator shall be UL864 listed to provide point identification of alarm, supervisory, security and trouble events to a Central or Remote Receiving Station. The DACT shall support the following.

1. Ademco Contact ID or SIA protocol
2. Ademco Contact ID selection shall provide the ability to transmit events for up to 999 individual zones
3. SIA selection shall provide the ability to transmit events for up to 10,000 individual points
4. Programming of accounts and phone numbers
5. Cellular connectivity.
6. Line fault monitoring.
7. Automatic 24-hour test
8. The DACT supports configurable alarm, alarm restoral, trouble, trouble restoral, supervisory, supervisory restoral, and reset events.
9. The DACT supports Ademco Contact ID alarm event codes for general alarm, smoke detector alarm, waterflow alarm, duct alarm, and manual alarm events.
10. Optionally, the DACT can be programmed to report events by event queue only.

2.13 COMMERCIAL CELLULAR LTE COMMUNICATOR

A. Provide Starlink SLETEVI-CFB-PS, Advanced LTE Dual Diversity Antenna for optimized performance or equal as follows:

1. 3 LED Indicators - Green, Signal Strength; Amber- Busy/ Activation; Red-Trouble
2. Patented Signal Boost™ signal amplification circuit and highgain performance antennae
3. Operating Environment: 0 to 49º C (32-120ºF), up to 93% humidity (non-condensing)
4. 12V - 24V Universal FACP Support, auto-current sensing. Support all brands communicating in Contact ID and 4/2
5. Locking Metal Enclosure with Hinged door & 2 key-slots for wall mounting (LED indicators, inside)
6. Dimensions: 9-5/8”x 11-3/4” x 3-3/8” D (HxWxD) • Weight: 8 lbs (max., power supply models)
7. Electrical Ratings for 120VAC, 60Hz • For Models with Power Supply: • Input Voltage: 120VAC Nominal • Input Current: 400mA maximum • Maximum Charging Current: 200mA
8. The Communicators shall each be installed to meet the requirements of NFPA 72, 2013 for Secondary Power as required for Remote Station Supervising Station reporting. The system shall be programmed to report, as required in NFPA 72, 2013 for sole path reporting. The equipment supplier shall provide monitoring by a UL Listed supervising station and include the first-year monitoring fee as part of this contract. This contractor shall wire, connect, and test the operation of the communicators.
9. Project shall include one years’ annual monitoring of the Fire Alarm System. Monitoring shall be provided by a UL listed, approved Central Station. The Central Station shall be approved by the Professional Engineer and authority having jurisdiction and include required daily test reporting.

2.14 WIRING METHODS

A. Pathways above recessed ceilings, unfinished spaces and in non-accessible locations shall be fire alarm MC cable.

1. Exposed wall mounted pathways in finished spaces shall be installed in surface mounted metallic raceway. Finish and routing of surface mount raceway to be approved by architect.
2. Exposed wall mounted pathways in unfinished spaces shall be installed in EMT.
3. Exposed ceiling pathways in finished spaces shall be installed in EMT, boxes and conduit shall be painted to match the surrounding finish. Verify with fire marshal prior to finishing.

B. All fire alarm system conduit and junction boxes in unfinished spaces and above ceiling shall be painted red enamel.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

B. Equipment Mounting: Install fire-alarm control unit on finished floor.

1. Comply with requirements for seismic-restraint devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."

C. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.

1. Comply with requirements for seismic-restraint devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches (1520 mm) of the exit doorway.
2. Mount manual fire-alarm box on a background of a contrasting color.
3. The operable part of manual fire-alarm box shall be between 42 inches (1060 mm) and 48 inches (1220 mm) above floor level. All devices shall be mounted at the same height unless otherwise indicated.

E. Smoke- or Heat-Detector Spacing: Comply with NFPA 72.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches (9100 mm) long shall be supported at both ends.

G. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

3.2 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Smoke dampers in air ducts of designated HVAC duct systems.
2. Magnetically held-open doors.
3. Electronically locked doors and access gates.
4. Alarm-initiating connection to elevator recall system and components.
5. Alarm-initiating connection to activate emergency lighting control.
6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
7. Supervisory connections at valve supervisory switches.
8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
9. Supervisory connections at elevator shunt-trip breaker.
10. Supervisory connections at fire-extinguisher locations.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Provide machine printed address labels on all addressable devices to be visible from the floor.

C. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.5 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visual Inspection: Conduct visual inspection prior to testing.

   a. Inspection shall be based on completed record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter.
   b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.

4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

D. Fire-alarm system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

G. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.6 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.7 DEMONSTRATION AND TRAINING

A. The contractor shall compile and provide to the owners three (3) complete manuals on the completed system to include SITE SPECIFIC operating and maintenance instruction, catalog cuts of all equipment and components, as-built wiring diagrams and a manufacturer’s suggested spare parts list. An operational Video, on DVD media, shall also be included.

B. In addition to the above manuals, the Electrical Contractor shall provide the services of the manufacturer’s trained representative for **two (2)** separate calendar days for a period of four **(4) hours** per day to instruct the owners’ designated personnel on the operation and maintenance of the entire system.

C. As-built drawings shall consist of the following:

1. Complete revision of all previously submitted drawings.
2. Point-to-point depiction of all device wiring on the device layout floor plans
3. One (1) set of B-size, laminated as-built drawings.
4. Two (2) sets of 30” x 42” 1/16” = 1’ scale drawings showing all points of the fire alarm. One set shall be submitted with the closeout documents. Second set shall be mounted in frame with lexan cover. These drawings must be submitted to project Engineer for approval.

D. Turnover of all software database hard/soft copies shall be required. This shall include all possible programming software logs, diskettes or CDs containing exported project files, hard copies of all device maps, the revision number of the version of programming utility used, and all required passwords.

3.8 FINAL TEST

A. Before the installation shall be considered completed and acceptable by the awarding authority, a test of the system shall be performed as follows:

1. The contractor's job foreman, a representative of the Owner, and the fire department shall operate every building fire alarm device to ensure property operation and correct annunciation at the control panel.
2. At least one half of all tests shall be performed on battery standby power.
3. Where application of heat would destroy any detector, it may be manually active.
4. The communication loops and the indicating appliance circuits shall be opened in at least two (2) locations per circuit to check for the presence of correct supervision circuitry.
5. When the testing has been completed to the satisfaction of both the contractor's job foreman and Owner, a notarized letter cosigned by each attesting to the satisfactory completion of said testing shall be forwarded to the Owner and the fire department.
6. The contractor shall leave the fire alarm system in proper working order, and without additional expense to the owner, shall replace any defective materials r equipment provided by him under this contract within one year (365 days) from the date of final acceptance by the awarding authority.
7. Prior to final test the fire department must be notified in accordance with local requirements.

END OF SECTION 28 31 11

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Removing above- and below-grade site improvements.
2. Temporary erosion and sedimentation control.

1.3 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.6 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

C. Burning: burning is not permitted.

1.7 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: PA One Call for area where Project is located before site clearing.

C. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with MPI #23 surface-tolerant, anticorrosive metal primer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations.

3.4 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.
2. Owner will arrange to shut off indicated utilities when requested by Contractor.

B. Locate, identify, and disconnect utilities indicated to be abandoned in place.

C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Engineer's written permission.

3.5 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove paving, curbs and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Mill-notch Joints: Mill existing paving back from saw cut joint to dimensions indicated before sawcutting full depth.
3. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 10 00

SECTION 31 20 00 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Preparing stone layer pavements.
2. Base course for asphalt paving.

B. Related Requirements:

1. Section 311000 "Site Clearing" for site stripping, and removal of above- and below-grade improvements.

1.3 UNIT PRICES

A. Work of this Section is affected by unit prices for stone removal & replacement specified in Section 012200 "Unit Prices."

B. Quantity allowances for stone removal & replacement are included in Section 012100 "Allowances."

1.4 DEFINITIONS

A. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below top of stone or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

B. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

C. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

D. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct pre-excavation conference at Project site.

1. Review methods and procedures related to earthmoving, including, but not limited to, the following:

a. Personnel and equipment needed to make progress and avoid delays.
b. Coordination of Work with utility locator service.
c. Extent of trenching by hand or with air spade.
d. Remediation measures for unsuitable material.
e. Authorization procedures for Changes in Work.
f. Field quality control.

1.6 ACTION SUBMITTALS

A. Samples for Verification: For the following products, in sizes indicated below:

1. Warning Tape: 12 inches long; of each color.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow stone material as follows:

1. Classification according to ASTM D2487.
2. Laboratory compaction curve according to ASTM D698.

C. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.8 QUALITY ASSURANCE

A. Codes and Standards: Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.

B. Testing and Inspection Service: Owner will employ and pay for a qualified independent geotechnical testing and inspection laboratory to perform on-site soil testing and inspection service during earthwork operations. Off-site testing shall be the Contractor's responsibility.

C. Testing Laboratory Qualifications: To qualify for acceptance the geotechnical testing laboratory must demonstrate to Engineer's satisfaction, based on evaluation of laboratory- submitted criteria conforming to ASTM E- 699, that it has the experience and capability to conduct required field and laboratory geotechnical testing without delaying the progress of the Work.

D. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

E. Pre-excavation Conference: Conduct conference at Project site.

F. Contractor Responsibilities:

1. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

   a. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
   b. Engage a qualified testing agency to perform these quality-control services.

      1) Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

   c. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
   d. Submit a certified written report, in duplicate, of each quality-control service.

G. Department of Environmental Protection Bureau of Land Recycling and Waste Management – Clean Fill Policy:

1. Reference Department of Environmental Protection Bureau of Land Recycling and Waste Management Document No. 258-2182-773 in the Contract Conditions.

   a. Imported Fill: The Contractor shall perform environmental due diligence to determine whether imported fill is clean or regulated as specified in DEP Clean Fill Policy. The Contractor shall manage the fill following the guidelines of the policy including the furnishing of any calculations, testing, or permits that may be required. Testing that may be required shall be included in the General Contractor’s Base Bid.
   b. Exported Fill: The Contractor shall perform due diligence and testing to determine that the excavated material scheduled to be spoiled off site qualifies as clean fill under DEP Clean Fill Policy. Should materials be uncovered that are suspected of being other than clean fill, the General Contractor shall immediately notify the Engineer. Testing requirements shall be included in the General Contractor’s Base Bid. If evidence of release of regulated substance is found, material shall be disposed of as regulated fill and will be paid for by Change Order

1.9 FIELD CONDITIONS

A. Site Information: Data in subsurface investigation reports was used for the basis of the design and is made available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings/test pits. The Engineer or Owner will not be responsible for interpretations or conclusions drawn by this data by the Contractor.

1. Additional test borings and other exploratory operations may be performed by the Contractor, at the Contractor’s expense and option; however, no change in the Contract Sum will be authorized for such additional exploration.

B. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

C. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Engineer.

D. Utility Locator Service: Notify "PA One Call" before beginning earth-moving operations.

E. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control specified measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS:

A. General: Provide borrow stone materials when sufficient satisfactory stone materials are not available from excavations.

B. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

C. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

2.2 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Provide dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. If fill or other deleterious soil conditions are encountered notify Engineer immediately. Proceed with over excavation and other remedial efforts only upon receipt of written permission.

1. Measure and document extents of over excavation. Verify quantities with a representative of the Owner.

B. Unclassified Excavation:

1. Excavation shall be Unclassified to a depth of subgrade.
2. Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
3. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.5 EXCAVATION FOR PAVEMENTS

A. Excavate surfaces under pavements to indicated lines, cross sections, elevations, and subgrades.

3.6 SUBGRADE INSPECTION

A. Notify Engineer when excavations have reached required subgrade.

B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. In the presence of the Engineer, roof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons at a speed no greater than 3- miles per hour to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction

activities, as directed by Engineer, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Engineer.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Engineer.

B. Fill unauthorized excavation under pavement with sub-base material.

3.8 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, damp proofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.9 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D698:

1. Under pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 98 percent.

3.10 SUBBASE AND BASE COURSES UNDER PAVEMENTS

A. Place subbase course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course under pavements and walks as follows:

1. Place base course material over subbase course under hot-mix asphalt pavement.
2. Shape subbase course to required crown elevations and cross-slope grades.
3. Place subbase course 6 inches or less in compacted thickness in a single layer.
4. Place subbase course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
5. Compact subbase course at optimum moisture content to required grades, lines, cross sections, and

thickness to not less than 98 percent of maximum dry unit weight according to ASTM D698.

3.11 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
2. Determine that fill material classification and maximum lift thickness comply with requirements.

3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2937, and ASTM D6938, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 1,500 sq. ft. or less of paved area or building slab but in no case fewer than three tests.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.12 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.13 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 20 00

SECTION 31 23 19 - DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes construction dewatering.

B. Related Requirements:

1. Section 312000 "Earth Moving" for excavating, backfilling, site grading, and controlling surface-water runoff and ponding.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site as part of the preconstruction meeting or regular construction conference.

1. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review condition of site to be dewatered including coordination with temporary erosion-control measures and temporary controls and protections.
3. Review geotechnical report.
4. Review proposed site clearing and excavations.
5. Review existing utilities and subsurface conditions.
6. Review observation and monitoring of dewatering system.

1.4 ACTION SUBMITTALS

A. Shop Drawings: For dewatering system, prepared by or under the supervision of a qualified professional engineer.

1. Include plans, elevations, sections, and details.
2. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
3. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
4. Include written plan for dewatering operations including sequence of well and well-point placement coordinated with excavation shoring and bracings and control procedures to be adopted if dewatering problems arise.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, land surveyor, and professional engineer.

B. Field quality-control reports.

C. Existing Conditions: Using photographs or video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by dewatering operations. Submit before Work begins.

D. Record Drawings: Identify locations and depths of capped wells and well points and other abandoned-in-place dewatering equipment.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer that has specialized in design of dewatering systems and dewatering work.

1.7 FIELD CONDITIONS

A. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from this data.

1. Make additional test borings and conduct other exploratory operations necessary for dewatering according to the performance requirements.
2. The geotechnical report is included elsewhere in Project Manual.

B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

1. Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer.
2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
3. Prevent surface water from entering excavations by grading, dikes, or other means.
4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
5. Remove dewatering system when no longer required for construction.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Provide temporary grading to facilitate dewatering and control of surface water.

D. Protect and maintain temporary erosion and sedimentation controls during dewatering operations.

3.2 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

1. Space well points or wells at intervals required to provide sufficient dewatering.
2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

B. Place dewatering system into operation to lower water to specified levels before excavating below ground-water level.

C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

3.3 OPERATION

A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

B. Operate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.

1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
3. Maintain piezometric water level a minimum of 24 inches below bottom of excavation.

C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

D. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

3.4 FIELD QUALITY CONTROL

A. Observation Wells: Provide observation wells or piezometers, take measurements, and maintain at least the minimum number indicated; additional observation wells may be required by authorities having jurisdiction.

1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

B. Survey-Work Benchmarks: Resurvey benchmarks monthly during dewatering and maintain an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

C. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

D. Prepare reports of observations.

3.5 PROTECTION

A. Protect and maintain dewatering system during dewatering operations.

B. Promptly repair damages to adjacent facilities caused by dewatering.

END OF SECTION 31 23 19

SECTION 31 25 00 - EROSION & SEDIMENTATION CONTROLS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. The work includes the provision of temporary and permanent erosion control measures to prevent environmental pollution within the project limits, outside the project limits where work is accomplished in conjunction with the project, and in adjacent and down-gradient areas.
2. Contractor shall apply for and obtain an approval of the NPDES Transferee/Co-Permittee Application to be added as a co-permittee.

B. Related Documents

1. Chapter 102 of the Pennsylvania Department of Environmental Protection Rules and Regulations, most current edition.

    a. PA-DEP Document #3150-PM-BWE0228 “Transferee/Co-Permittee Application for a General or Individual NPDES Permit for Stormwater Discharges Associated with Construction Activities.”
    b. PA-DEP Document #3150-PM—BWEW0229b “Notice of Termination for a General or Individual Permit for Stormwater Discharges Associated with Construction Activities.”

2. Municipal ordinances and regulations for environmental protection.
3. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
4. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specifications apply to this section.
5. Section 312000 “Earth moving” preparing subgrades for turf and grasses.
6. Section 329200 "Lawns and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
7. Section 329300 "Exterior Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

1.3 REFERENCES

A. The publications listed below, in their most recent version, form a part of this specification to the extent referenced.

1. ASTM INTERNATIONAL (ASTM)

    a. ASTM D 3787 Bursting Strength of Textiles -Constant-Rate-of-Traverse (CRT), Ball Burst Test.
    b. ASTM D 4355 Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus.
    c. ASTM D 4533 Trapezoid Tearing Strength of Geotextiles.
    d. ASTM D 4632 Grab Breaking Load and Elongation of Geotextiles.
    e. ASTM D 5141 Determining Filtering Efficiency and Flow Rate of a Geotextile for Silt Fence Application Using Site-Specific Soil Control Handbook.

1.4 SUBMITTALS

A. Preconstruction Submittals:

1. Construction Sequence Schedule
2. Product Data
3. Filter Barriers
4. Silt Soxx
5. Sediment Fence
6. Dust Suppressors
7. Erosion Control Matting
8. Filter Fabric

B. CONSTRUCTION SEQUENCE SCHEDULE: Submit a Contractor furnished construction work sequence schedule, a minimum of 30 days prior to start of construction. The work schedule shall coordinate the timing of land disturbing activities with the provision of erosion control measures to reduce on site erosion and off-site sedimentation. Installation of temporary erosion control features shall be coordinated with the construction of permanent erosion control features to assure effective and continuous control of erosion and pollution.

PART 2 - PRODUCTS

2.1 FILTER BARRIERS

A. Silt Soxx

1. Approved manufacturer Filtrexx or approved equal.

B. Filter Fabric Fence

1. Ensure that silt fence filter fabrics have the following characteristics:

   a. Has strong rot-proof synthetic fibers formed into either a woven or non-woven fabric.
   b. Has no treatment or coating that might significantly alter its physical properties after installation.
   c. Contains stabilizers and/or inhibitors to make the filaments resistant to deterioration resulting from exposure to sunlight or heat.
   d. Makes a pervious sheet of synthetic fibers oriented into a stable network so that the fibers retain their relative position with respect to each other under normal handling, installation, and service conditions.
   e. Has finished fabric edges to prevent the outer yarn from pulling away from the fabric.
   f. Has no defects or flaws that would significantly affect its physical and/or filtering properties.

2. Meets the following physical or dimensional requirements:

   a. Minimum tensile strength, pounds: Warp – 120 (530)
   b. Fill – 100 (445)
   c. Elongation (% Max.): 40
   d. Apparent opening size (max. sieve size): No. 30
   e. Flow rate, gal/ min./ft^2: 25
   f. Ultraviolet stability: 80
   g. Bursting strength, psi: 175
   h. Minimum fabric width: 36 in

2.2 CONSTRUCTION ENTRANCE

A. Construction Entrance

1. Aggregate: as indicated.

2. Filter Fabric: A woven or nonwoven polypropylene, nylon, or polyester containing stabilizers and/or inhibitors to make the fabric resistant to deterioration from ultraviolet, and with the following properties:

    a. Minimum grab tensile strength (TF 25 #1/ASTM D 4632) .8 kN 180 pounds
    b. Minimum Puncture (TF 25 #4/ASTM D 3787) .52 MPa 75 psi in the weakest direction.
    c. Apparent Opening Size 40-80 (U.S. Sieve Size)
    d. Minimum Trapezoidal tear strength (TF 25 #2/ASTM D 4533) .22 kN 50 pounds

2.3 DUST SUPPRESSORS

A. Calcium chloride, or other standard manufacturer's spray on adhesives designed for dust suppression.

2.4 TEMPORARY SEEDING

A. Provide seed, lime, amendments and fertilizer as indicated.

B. Provide hay or straw mulch.

2.5 EROSION CONTROL MATTING

A. Jute, excelsior, or paper matting that has not been bleached or dyed.

1. Jute Matting: Uniform open plain weave of single jute yarn providing an average weight of .5 kg per square meter 0.9 pounds per square yard of matting. Yarn shall be of a loosely twisted construction and shall not vary in thickness by more than one-half its normal diameter. Matting shall have openings between strands length wise of 0.45 to 0.75 inch, and between strands crosswise of 0.67 to 1.13 inch.
2. Excelsior Matting A machine produced mat of wood excelsior with a minimum of 80 percent of wood fibers 152 mm 6 inches in length or longer. The matting shall have an average weight of .41 to . 0.75 to 0.85 pounds per square yard with an even fiber distribution producing a consistent mat thickness, and shall have on one side a woven fabric. The woven fabric shall be twisted paper cord, cotton cord, or an extruded plastic mesh with a minimum mesh size of one by one inch and a maximum mesh size of 1 1/2 by 3 inch.
3. Paper Matting Shall be a knitted polypropylene yarn with uniform openings with biodegradable paper strips continuously interwoven. The matting shall weigh a minimum of 0.09 pounds per square yard with maximum openings of 3/4 inch and minimum openings of 1/2 inch.
4. Straw Matting A machine produced straw mat with a minimum thickness of 1/2 inch +/- 1/8 inch. The straw shall be evenly distributed throughout the mat to provide a minimum average dry weight of .70 pounds per square yard. The topside of the mat shall be covered with a 3/8-inch biodegradable plastic mesh, with the mesh attached to the straw by a knitting process using biodegradable thread.

B. Provide matting in minimum widths of 4- feet.

C. Staples for anchoring the matting shall be

1. Minimum 11 gage wire, formed into a "U" shape with a minimum throat width of one inch and minimum length of 6 inches after forming.

D. Provide other types of matting of the type and in location indicated

PART 3 - EXECUTION

3.1 GENERAL

A. Soil Erosion and Sedimentation (E&S) Control: Provide preventative control measures to prevent erosion or displacement of soils and discharge of soil-bearing run-off or airborne dust to adjacent properties and roadways in compliance with the Contract Drawings and the following provisions:

1. This Work shall be as required by Chapter 102 of the Pennsylvania Department of Environmental Protection Rules and Regulations, most current edition, and shall consist of temporary control measures during the life of the Contract to effectively control land erosion and water pollution.
2. Establish and maintain control measures as required local and State code, and as indicated on the Erosion & Sedimentation Control Plans, approved by the County Conservation District.
3. Contractor shall carry out the construction operations in a manner that soil erosion and resulting turbid storm water runoff and sedimentation are minimized and to limit downstream property damage.
4. This is not to construe that the indicated control measures limit the Contractor in accomplishing the intent of Chapter 102. The indicated measures are the minimum recommended and required. Supplemental measures necessary to control accelerated erosion and sedimentation may have to be provided by the Contractor at the Contractor's expense.

   The Contractor responsible for E&S controls shall contact the County Conservation District to obtain an NPDES Co-Permittee Application prior to any earth disturbance activities, if required. Such Contractor shall complete the application and remain a co-permittee until construction is complete. Responsibilities include, but are not limited to, visual inspections and reports at periodic intervals stated in the permit information, maintenance of devices and application of control measures, and replacement of failed or damaged devices as indicated or directed. Upon completion of the Project and final acceptance by the County Conservation District and Owner, such Contractor shall transfer the permit back to the Owner.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 INSTALLATION AND MAINTENANCE OF EROSION AND SEDIMENTATION CONTROL MEASURES

A. General:

1. Install Erosion and Sedimentation Controls and perform other work in accordance with the permitted Construction Sequence.

B. Installation of Rock Construction Entrance:

1. Install Rock Construction Entrance at the location and to the dimensions indicated.
2. Excavate to the dimensions required.
3. Place Geotextile.
4. Fill with rock to the required elevation.

C. Installation of Silt Sox

1. Silt Sox shall be used for perimeter control of sediment and soluble pollutants in storm runoff.
2. Silt Sox will be placed at locations indicated on plans as directed by the Engineer.
3. Silt Sox should be installed parallel to the base of the slope or other disturbed area. In extreme conditions (i.e., 2:1 slopes), a second Silt Sox shall be constructed at the top of the slope.
4. Stakes shall be installed through the middle of the Silt Sox on 10 ft (3m) centers, using 2 in by 2 in by 3 ft (1m) wooden stakes. In the event staking is not possible, i.e., when Silt Sox are used on pavement, heavy concrete blocks shall be used behind the SiltSox to help stabilize during rainfall/runoff events.
5. Staking depth for sand and silt loam soils shall be 12 in, and 8 in for clay soils.

6. Loose compost may be backfilled along the upslope side of the Silt Sox, filling the seam between the soil surface and the device, improving filtration and sediment retention.
7. Silt Sox are not to be used in perennial, ephemeral, or intermittent streams.
8. See design drawing and details for correct installation.
9. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

D. Installation of Filter Fabric Fence

1. Excavate a trench to required depth using equipment such as a trenching machine or motor grader. If equipment cannot be operated on the site, excavate the trench by hand.
2. Install the first post at the center of the low point (if applicable). Space the remaining posts as indicated. Do not exceed maximum spacing.
3. Bury the posts at least 18 inches into the ground. If this depth cannot be attained, secure the posts enough to prevent the fence from overturning from sediment loading.
4. Attach the filter fabric to the post using wire, cord, staples, nails, pockets, or other acceptable means.
5. Staples and Nails (Wood Posts): Evenly space staples or nails with at least five per post.
6. Pockets: If using pockets, and they are not closed at the top, attach the fabric to a wood post using at least one additional staple or nail, or to a steel post using wire.
7. Ensure that the additional attachment is within the top 6 inches of the fabric.
8. Install the filter fabric so that 6 to 8 inches of fabric is left at the bottom to be buried. Provide a minimum overlap of 18 inches at all splice joints.
9. Install the fabric in the trench so that 4 to 6 inches of fabric is against the side of the trench with 2 to 4 inches of fabric across the bottom in the upstream direction.
10. Backfill and compact the trench to ensure that flow cannot pass under the barrier. When the slice method is used, compact the soil disturbed by the slice on the upstream side of the silt fence first, and then compact the downstream side.

E. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

1. General: Conduct routine inspections within 24 hours of a runoff event or as designated by the regulating authority.
2. Inspection and Maintenance of Rock Construction Entrance:

    a. Maintain stockpile of stone to use in maintaining the entrance.
    b. Add rock as needed to maintain the level and effectiveness of the Rock Construction Entrance.

3. Inspection and Maintenance of Silt Sox:

    a. Regularly inspect Silt Sox to make sure they maintain their shape and are producing adequate hydraulic flow-through. If ponding becomes excessive, additional Silt Sox may be required to reduce effective slope length or sediment removal may be necessary. Silt Sox shall be inspected until area above has been permanently stabilized and construction activity has ceased
    b. Maintain the Silt Sox in a functional condition at all times and it shall be routinely inspected.
    c. If the Silt Sox has been damaged, it shall be repaired, or replaced if beyond repair.
    d. Remove sediment at the base of the upslope side of the Silt Sox when accumulation has reached 1/2 of the effective height of the Silt Sox, or as directed by the Engineer. Alternatively, a new Silt Sox can be placed on top of and slightly behind the original one creating more sediment storage capacity without soil disturbance.
    e. Silt Sox shall be maintained until disturbed area above the device has been permanently stabilized and construction activity has ceased.
    f. The compost will be dispersed on site once disturbed area has been permanently stabilized, construction activity has ceased, or as determined by the Engineer.
    g. For long-term sediment and pollution control applications, Silt Sox can be seeded at the time of installation to create a vegetative filtering system for prolonged and increased filtration of sediment and soluble pollutants (contained vegetative filter strip). The appropriate seed mix shall be determined by the Engineer.
    h. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

4. Inspection and Maintenance of Filter Fabric Fence

    a. Inspect filter fabric fence regularly as well as after each rainfall event.
    b. Remove accumulated sediments from the fence base when sediment reaches one third to one half the height of the fence.
    c. Construct Rock Filter Outlet at any section of fence that has been undermined or topped.

F. Erosion Control Matting

1. Place matting in the direction of the flow of water.
2. The up channel matting end shall be toed in a narrow trench a minimum of 5 inches deep.
3. Where one roll of matting ends and a second roll begins, the end of the upper roll shall be brought over the buried end of the second roll, to provide a 6 inch overlap.
4. Where matting widths are laid side by side, the overlap between matting shall be 4 inches.
5. Provide check slots every 50 feet longitudinally in the matting.

    a. Construct check slots by providing a narrow trench 5 inches deep and folding the matting down in to the trench, across the bottom of the trench, and then back up the trench to the existing ground
    b. Backfill and compact the trench using the excavated material from the trench. Staple matting ends, junctions, and check slots at 10 inches on center.

G. Staple matting outer edges and overlaps and the center of each matting strip at 3 feet on center. Install excelsior matting with the woven fabric on top.

3.3 SITE STABILIZATION

A. Immediately stabilize all cleared and graded earth as indicated.

B. Stabilize slopes greater than 3:1 as indicated and in compliance with the product manufacturer's written recommendations unless otherwise indicated.

C. Temporary Seeding

1. Time Restrictions: Within 48 hours after attaining the grading increment specified herein, provide seed, fertilizer, mulch and water on graded areas when any of the following conditions occur:

    a. Grading operations stop for an anticipated duration of 4 consecutive days or more.
    b. When it is impossible or impractical to bring an area to finish grade so that permanent seeding operations can be performed without serious disturbance from additional grading.
    c. Grading operations for a specific area are completed and the seeding seasons specified for permanent seeding is more than 4 days away.
    d. When an immediate cover is required to minimize erosion, or when erosion has occurred.
    e. Provide on erosion control devices constructed using soil materials.
    f. Seeding Requirements: Provide seed, lime, and fertilizer as indicated. Provide hay or straw mulch in an air-dried condition, and secure mulch in place.
    g. Loosen soil to a depth of 2-4 inches. Uniformly apply the seed, fertilizer, and mulch at the specified application rates. Do not seed or fertilize when the Engineer determines conditions are unfavorable. Provide fertilizer at the rate of 1000 pounds per acre. Spread mulch at the rate of 1.5 tons per acre and anchor by crimping mulch with a disc. Provide water on a regular basis to promote turf growth. Areas which fail to establish vegetative cover adequate to prevent rill erosion shall be reseeded as soon as these areas are identified.
    h. Provide seed type and quantity pounds per acre as indicated.

D. Permanent Seeding

1. Temporary seeding shall be removed, and permanent seeding shall be provided during the specified planting season as indicated.
2. Comply with Section 329200 "Lawns and Grasses."

3. Site shall be considered to have achieved final stabilization when it has a minimum uniform 70-percent perennial vegetative cover or other non-vegetative cover with a density sufficient to resist accelerated surface erosion and subsurface characteristics sufficient to resist sliding and other movements.

3.4 MAINTENANCE AND INSPECTION

A. Inspect erosion control devices after each rainfall and daily during prolonged rainfall.

B. Remove sediment deposits after each rainfall or when sediment reaches approximately one-half the barrier height.

C. Immediately repair damaged erosion control devices and damaged areas around and underneath the devices.

D. Maintain erosion control devices to assure continued performance of their intended function. Modify the erosion control plan as required to control problem areas noticed after each inspection. Modifications shall be approved by the Engineer.

E. Submit a Discharge Monitoring Report at the frequency required by the County Conservation District.

3.5 UNCONTROLLED SEDIMENT RELEASE

A. In the event of an uncontrolled sediment pollution event, follow all PA DEP Chapter 102 guidelines and NPDES Permitting requirements; report pollution event to Owner, Engineer and local Conservation District; immediately take action to control pollution event and eliminate discharge by installing additional erosion control measures and/or repairing existing erosion control measures; clean up any sediment that has accumulated outside of erosion controls and stabilize any areas disturbed by cleanup.

3.6 CLEAN UP

A. At the completion of the job, or when directed or approved by the County Conservation District or Engineer, temporary erosion control devices shall be removed.

B. Erosion control devices and areas immediately adjacent to the device shall be filled (where applicable), shaped to drain and to blend into the surrounding contours, and provided with permanent seeding. Erosion control devices may remain in place after job completion when approved by the Conservation District.

END OF SECTION 31 25 00

SECTION 32 31 13 - DECORATIVE METAL FENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Decorative ornamental aluminum fencing.
2. Posts, rails, pickets, fasteners, and accessories required for a complete installation.

B. Related Sections:

1. Section 03 30 00 – Cast-in-Place Concrete.

1.3 REFERENCES

A. ASTM B221 – Aluminum and Aluminum-Alloy Extrusions.

1.4 SUBMITTALS

A. Product Data, Shop Drawings, and Samples.

1.5 QUALITY ASSURANCE

A. Manufacturer with minimum five (5) years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect materials from damage and weather.

1.7 WARRANTY

A. Manufacturer’s standard warranty.

PART 2 - PRODUCTS

2.1 BASIS OF DESIGN

A. Jerith Industrial Series, Style #202 Drop Bottom (DB).

2.2 MATERIALS

A. Fence Panels:

1. Height: 48 inches.

2. Three (3) horizontal rails.
3. 1-inch square aluminum pickets.
4. Panel width: 72 inches actual.

B. Posts:

1. 2-1/2 inch square aluminum posts.

C. Finish:

1. Black powder-coated finish.

D. Accessories:

1. Provide all brackets, caps, fasteners, and accessories required for complete installation.

2.3 CONCRETE FOR FENCE POSTS

A. Provide concrete for setting fence posts that is either PennDOT-approved ready-mixed concrete or PennDOT-approved packaged (bagged) concrete, as specified or permitted.

B. Ready-Mixed Concrete: Ready-mixed concrete shall be produced by a supplier approved by the Pennsylvania Department of Transportation and listed on PennDOT Bulletin 15 at the time of bid. Concrete shall conform to ASTM C94/C94M and shall have a minimum compressive strength of 3,000 psi at 28 days. Aggregates shall comply with ASTM C33. Concrete may be air-entrained where exposed to freeze-thaw conditions. Do not use admixtures containing chlorides. Maximum slump shall be 4 inches, unless otherwise accepted by the Engineer.

C. Packaged (Bagged) Concrete: Packaged concrete shall be a PennDOT-approved preblended product listed on PennDOT Bulletin 15, suitable for use in fence post installation. Packaged concrete shall comply with ASTM C387 and achieve a minimum compressive strength of 3,000 psi at 28 days. Use products specifically formulated for post-setting applications. Mix, place, and cure in accordance with the manufacturer's written instructions and approved submittals.

D. Concrete shall be suitable for placement in augered or excavated post holes and capable of fully encapsulating fence posts without segregation or excessive bleed water.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install plumb, level, and true to line.

B. Install in accordance with manufacturer's written recommendations and approved shop drawings.

3.2 CLEANING AND PROTECTION

A. Clean surfaces and protect from damage.

END OF SECTION 32 31 13

SECTION 31 50 00 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes temporary excavation support and protection systems.

B. Related Requirements:

1. Section 312000 "Earth Moving" for excavating and backfilling, for controlling surface-water runoff and ponding, and for dewatering excavations.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at the project site.

1. Review geotechnical report.
2. Review existing utilities and subsurface conditions.
3. Review coordination for interruption, shutoff, capping, and continuation of utility services.
4. Review proposed excavations.
5. Review proposed equipment.
6. Review monitoring of excavation support and protection system.
7. Review coordination with waterproofing.
8. Review abandonment or removal of excavation support and protection system.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, performance properties, and dimensions of individual components and profiles, and calculations for excavation support and protection system.

B. Shop Drawings: For excavation support and protection system, prepared by or under the supervision of a qualified professional engineer.

1. Include plans, elevations, sections, and details.
2. Show arrangement, locations, and details of soldier piles, piling, lagging, tiebacks, bracing, and other components of excavation support and protection system according to engineering design.
3. Indicate type and location of waterproofing.
4. Include a written plan for excavation support and protection, including sequence of construction of support and protection coordinated with progress of excavation.

C. Delegated-Design Submittal: For excavation support and protection systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Land surveyor.
2. Professional Engineer: Experience with providing delegated-design engineering services of the type indicated, including documentation that engineer is licensed in the state in which Project is located.
3. Installer: Engage an experienced installer to assume engineering responsibility and perform work of this Section who has specialized in installing excavation support and protection systems similar to those required for this Project and with a record of successful in-service performance.

B. Contractor Calculations: For excavation support and protection system. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Existing Conditions: Using photographs or video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.

1.6 CLOSEOUT SUBMITTALS

A. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.7 FIELD CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility-serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Construction Manager and Owner's written permission.

B. A geotechnical report has been prepared for this Project and is available for information only. The report is part of the contract documents. The opinions expressed in this report are those of the engineer and represent interpretations of the subsoil conditions, tests, and results of analyses conducted by the engineer. Owner will not be responsible for interpretations or conclusions drawn from this data by the Contractor.

1. Make additional test borings and conduct exploratory operations as necessary

C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks, and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, to design excavation support and protection systems to resist all lateral loading and surcharge, including but not limited to, retained soil, groundwater pressure, adjacent building loads, adjacent traffic loads, construction traffic loads, material stockpile loads, and seismic loads, based on the following:

1. Compliance with OSHA Standards and interpretations, 29 CFR 1926, Subpart P.
2. Compliance with AASHTO Standard Specification for Highway Bridges or AASHTO LRFD Bridge Design Specification, Customary U.S. Units.
3. Compliance with requirements of authorities having jurisdiction.
4. Compliance with utility company requirements.

2.2 MATERIALS

A. Provide materials that are either new or in serviceable condition.

B. Structural Steel: ASTM A36/A36M, ASTM A690/A690M, or ASTM A992/A992M.

C. Steel Sheet Piling: ASTM A328/A328M, ASTM A572/A572M, or STM A690/A690M; with continuous interlocks.

D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of 3 inches.

E. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.

F. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

G. Tiebacks: Steel bars, ASTM A722/A722M.

H. Tiebacks: Steel strand, ASTM A416/A416M.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

1. Shore, support, and protect utilities encountered.

3.2 INSTALLATION - GENERAL

A. Locate excavation support and protection systems clear of permanent construction, so that construction and finishing of other work is not impeded.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.

D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure excavation support and protection systems remain stable.

E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems to the satisfaction of the Owner.

3.3 SOLDIER PILES AND LAGGING

A. Install steel soldier piles before starting excavation.

1. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement.
2. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging.

3. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

B. Install wood lagging within flanges of soldier piles as excavation proceeds.

1. Trim excavation as required to install lagging.
2. Fill voids behind lagging with soil, and compact.

C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.4 SHEET PILING

A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock vertical edges to form a continuous barrier.

B. Accurately place the piling using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer.

1. Limit vertical offset of adjacent sheet piling to 60 inches.
2. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

C. Cut tops of sheet piling to uniform elevation at top of excavation.

3.5 TIEBACKS

A. Drill, install, grout, and tension tiebacks.

B. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.

1. Have test loading observed by a qualified professional engineer responsible for design of excavation support and protection system.

C. Maintain tiebacks in place until permanent construction can withstand lateral earth and hydrostatic pressures.

3.6 BRACING

A. Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary, to move brace, install new bracing before removing original brace.

1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Engineer.
2. Install internal bracing if required to prevent spreading or distortion of braced frames.
3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.7 MAINTENANCE

A. Monitor and maintain excavation support and protection system.

B. Prevent surface water from entering excavations by grading, dikes, or other means.

C. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

3.8 FIELD QUALITY CONTROL

A. Survey-Work Benchmarks: Resurvey benchmarks daily during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open.

1. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions.
2. Promptly notify Engineer if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.

C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

3.9 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures.

1. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.
2. Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction and abandon remainder.
3. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earth Moving."
4. Repair or replace, as approved by Engineer, adjacent work damaged or displaced by removing excavation support and protection systems.

B. Leave excavation support and protection systems permanently in place.

END OF SECTION 31 50 00

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. PennDOT Publication 408.

1.2 SUMMARY

A. Section Includes:

1. Hot-mix asphalt paving.
2. Hot-mix asphalt overlay.
3. Cold milling of existing asphalt pavement.
4. Hot-mix asphalt patching.

B. Related Requirements:

1. Section 31 10 00 “Site Clearing” for demolition and removal of existing asphalt pavement.
2. Section 31 20 00 "Earth Moving" for subgrade preparation, fill material, separation geotextiles, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.

1.3 UNIT PRICES

A. Work of this Section is affected by:

1. Mill and Overlay
2. Full depth reclamation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.5 ACTION SUBMITTALS

A. Product Data: Include technical data and tested physical and performance properties.

1. Pavement mixes
2. Joint sealant.

B. Hot-Mix Asphalt Designs:

1. Certification, by authorities having jurisdiction, of approval of each hot-mix asphalt design proposed for the Work.
2. For each hot-mix asphalt design proposed for the Work.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For paving-mix manufacturer and testing agency.

B. Material Certificates: Include statement that mixes containing recycled materials will perform equal to mixes produced from all new materials.

1. Aggregates.
2. Asphalt binder.
3. Asphalt cement.
4. Cutback prime coat.
5. Emulsified asphalt prime coat.
6. Tack coat.
7. Fog seal.
8. Undersealing asphalt.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction/ PennDOT.

B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of PennDOT for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.8 DEFINTIONS

A. (Cold) Milling: Mechanical removal of existing asphalt pavement to a specified depth and profile using a cold milling machine, producing a uniform, textured surface suitable for placement of new asphalt pavement. Milling may include partial- or full-depth removal of asphalt layers and includes removal and lawful disposal or recycling of reclaimed asphalt pavement (RAP).

B. Overlay: Placement of one or more courses of new hot-mix asphalt (HMA) over an existing asphalt or milled pavement surface to restore structural capacity, improve ride quality, correct surface deficiencies, or extend pavement service life.

C. Mill and Overlay: A pavement rehabilitation process consisting of cold milling existing asphalt pavement to a specified depth, followed by placement of new hot-mix asphalt overlay to achieve the required finished grade, cross-slope, and pavement performance characteristics.

D. Full Depth Asphalt Replacement: Removal and legal disposal of existing asphalt pavement through its full thickness down to the top of the underlying stone sub-base, followed by placement of new asphalt pavement courses in accordance with the specified pavement section, details, grades, and performance requirements.

E. Full Depth Asphalt Reconstruction: Complete removal of existing asphalt pavement, underlying stone sub-base, and designated subgrade materials to the depths and cross sections indicated, followed by reconstruction of the pavement system, including subgrade preparation, new sub-base, and asphalt pavement courses, in accordance with the specified details, grades, and performance requirements.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F.
2. Tack Coat: Minimum surface temperature of 60 deg F.
3. Slurry Coat: Comply with weather limitations in ASTM D3910.
4. Asphalt Base Course and Binder Course: Minimum surface temperature of 40 deg F and rising at time of placement.
5. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D692/D692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

C. Fine Aggregate: ASTM D1073, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: PG 64-22.

B. Tack Coat: PennDOT Pub 408.

C. Water: Potable.

2.3 JOINT SEALANTS

A. Basis of Design Criteria: The Contract Documents indicate the requirements of joint sealants and are based on the specific sealant lines as indicated and as manufactured by Crafco. Sealants by the available manufacturers indicated below may be considered, provided there are no deviations in quality, coverage, elongation, solids by weight, viscosity, and other requirements indicated herein, implied or inherent in the basis of design product as solely by the Engineer. The burden of proof of equality is on the proposer. Engineer's approval does not relieve an available manufacturer from their responsibility of meeting the standards and requirements set forth in the specifications, and by the basis of design product.

1. Joint Sealant: Crafco Inc., an ERGON company; Roadsaver 522.

a. Cone Penetration, 77degrees F. 100-150 according to ASTM D5329
b. Cone Penetration, 0degrees F. 25 min according to ASTM D5329
c. Low, 140 dgrees F, 5h 10mm according to ASTM D5329
d. Resilience, 30-60% according to ASTM D5329
e. Bond, -20 degrees F, 200% ext. for a ½- thick specimen, 3 cycles according to ASTM D5329
f. Minimum application temperature, 380 degrees F
g. Maximum heating temperature, 400 degrees F
h. Unit weight 9.6 pounds per gallon at 60 degrees F

2.4 AUXILIARY MATERIALS

A. Stress Absorbing Membrane Interlayer: PETROTAC 4591 or equal reviewed and approved by Engineer.

1. Roll size: 24- inch

B. Joint Sealant: PG64-22 sealant.

2.5 PAVEMENT MARKINGS

A. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than 45 minutes.

1. Color:

a. White: Line striping
b. Yellow: Directional arrows, no parking zones.

2.6 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by PADOT. Provide mixes complying with composition, grading, and tolerance requirements as follows:

1. Base Course: Superpave Asphalt Mixture Design, HMA Base Course, PG 64-22, 0.3 to < 3 million ESALS, 25mm mix; as indicated.
2. Wearing Course: Superpave Asphalt Mixture Design, HMA Wearing Course, PG 64-22, 0.3 to 3 million ESALS, 9.5mm mix, SRL-G; as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protection: Provide protective materials, procedures, and worker training to prevent asphalt materials from spilling, coating, or building up on curbs, driveway aprons, manholes, and other surfaces adjacent to the Work.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.

3.3 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

1. Mill the depth indicated on the plans (varies by site).
2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
3. Control rate of milling to prevent tearing of existing asphalt course.
4. Repair or replace curbs, driveway aprons, manholes, and other construction damaged during cold milling.
5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
6. Patch surface depressions deeper than 1 inch after milling, before wearing course is laid.
7. Handle milled asphalt material in accordance with approved waste management plan.
8. Keep milled pavement surface free of loose material and dust.
9. Do not allow milled materials to accumulate on-site.

3.4 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

C. Placing Two-Course Patch Material: Partially fill excavated pavements with hot-mix asphalt base course mix and, while still hot, compact. Cover asphalt base course with compacted layer of hot-mix asphalt surface course, finished flush with adjacent surfaces.

3.5 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.

1. Clean cracks and joints in existing hot-mix asphalt pavement.
2. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.6 SURFACE PREPARATION

A. Ensure that prepared subgrade has been proof-rolled and is ready to receive paving. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces.

B. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.7 HOT-MIX ASPHALT PLACEMENT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at a minimum temperature of 250 deg F.
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
2. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.8 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method in accordance with AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.9 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density, Marshall Test Method: 96 percent of reference laboratory density in accordance with ASTM D6927, but not less than 94 percent or greater than 100 percent.

2. Average Density, Rice Test Method: 92 percent of reference maximum theoretical density in accordance with ASTM D2041/D2041M, but not less than 90 percent or greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.10 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: **1**/4 inch.
2. Surface Course: 1/8 inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

C. Asphalt Traffic-Calming Devices: Compact and form asphalt to the shapes indicated and within a tolerance of plus or minus 1/8 inch of height indicated above pavement surface.

END OF SECTION 32 12 16

SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Including the Following:

1. Curbs and gutters.
2. Walks, non-colored.

B. Related Requirements:

1. All other contract documents including but not limited to drawings.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

   a. Concrete mixture design.
   b. Quality control of concrete materials and concrete paving construction practices.
   c. Acceptable weather conditions.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

   a. Contractor's superintendent.
   b. Independent testing agency responsible for concrete design mixtures.
   c. Ready-mix concrete manufacturer.
   d. Concrete paving Subcontractor.
   e. Manufacturer's representative of stamped concrete paving system used for stamped detectable warnings.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when

characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For ready-mix concrete manufacturer and testing agency.

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

C. Material Test Reports: For each of the following:

1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete.

D. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Stamped Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.

B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

1.9 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

A. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, fabricated from steel wire into flat sheets.

B. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.

C. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A, plain steel.

D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

E. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.

F. Epoxy-Coated Reinforcing Bars: ASTM A775/A775M or ASTM A934/A934M; with ASTM A615/A615M, Grade 60 deformed bars.

G. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60 deformed bars; assembled with clips.

H. Plain-Steel Wire: ASTM A 1064/A 1064M, as drawn.

I. Deformed-Steel Wire: ASTM A 1064/A 1064M.

J. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel barszinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.

K. Epoxy-Coated, Joint Dowel Bars: ASTM A775/A775M; with ASTM A615/A615M, Grade 60 plain-steel bars.

L. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

M. Zinc Repair Material: ASTM A 780/A 780M.

N. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

2.4 CONCRETE MATERIALS

A. Provide materials in accordance with indicated standards of PADOT Pub 408, including but not limited to aggregates, Portland Cement Cementitious Materials, water and admixtures.

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry or cotton mats.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.6 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.

B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.7 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.

B. Cementitious Materials: Use non-expansive fly ash, pozzolan cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent

1. Fly Ash or Pozzolan: 25 percent.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: 5-1/2 percent plus or minus 1-1/2 percent for 1-1/2-inch nominal maximum aggregate size.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 “Earth Moving.”

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

F. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Provide tie bars at sides of paving strips where indicated.
3. Butt Joints: Use at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. Keyed Joints: Provide preformed bonding agent keyway -section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary

preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.

   a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

   a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.

3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 3/8-inchradius. Repeat tooling of edges after applying surface finishes.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms.

   Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3.8 DETECTABLE WARNING INSTALLATION

A. Comply with manufacturer’s written instructions.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.
b. Continuous water-fog spray.
c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.10 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-feet-long; unleveled straightedge not to exceed 1/2 inch.
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch.
6. Vertical Alignment of Dowels: 1/4 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231/C 231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg Fand below and when it is 80 deg Fand above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.

   a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three-consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.12 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 13 13

SECTION 32 13 73 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Cold-applied joint sealants.
2. Joint-sealant backer materials.
3. Primers.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

2.2 COLD-APPLIED JOINT SEALANTS

A. Multicomponent, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C 920, Type M, Grade P, Class 25, use T for horizontal expansion joints.

1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide hot-applied joint sealant manufactured by Tremco, Inc. or an approved comparable product.

a. Trecmo, Inc.; THC-900/901, color as selected by Engineer from manufacturer's full range.

2.3 JOINT-SEALANT BACKER MATERIALS

A. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.4 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Cleaning of Joints: Clean out joints immediately before installing joint sealants.

C. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

D. Install joint-sealant backings of kind indicated to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of joint-sealant backings.
2. Do not stretch, twist, puncture, or tear joint-sealant backings.
3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:

1. Remove excess joint sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

END OF SECTION 32 13 73

SECTION 32 93 00 – EXTERIOR PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Trees, shrubs, perennials, groundcover, and plants
2. Topsoil placement in planting areas.
3. Mulch and soil amendments.
4. Providing imported topsoil as required.

B. Related Requirements:

1. Section 31 10 00 “Site Clearing” for protection of existing trees, topsoil stripping and stockpiling.
2. Section 31 20 00 “Earthwork” for excavation, filling and rough grading.

1.3 COORDINATION

A. Coordinate planting operations with installation of utilities, site improvements, finish grading, and other Work affecting planting areas.

B. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.4 SUBMITTALS

A. Product Data Submittals: For each product.

1. Plant Materials: Include quantities, sizes, quality, and verified sources for plant materials.

2. Planting Soil Materials: Submit product data and material certifications for imported topsoil, compost, and soil amendments, including laboratory analysis demonstrating compliance with specified requirements.

B. Soil Testing: Contractor shall provide and pay for topsoil testing. The testing agency shall be acceptable to the Architect. Provide test data for the following:

1. pH factor.
2. Mechanical analysis.
3. Percentage of organic content.
4. Recommendations on type and quantity of additives required establishing satisfactory pH factor and supplying nutrients to a satisfactory level of planting.

C. Pesticides and Herbicides: Product label and manufacturer’s application instructions specific to Project.

D. Maintenance Data: Recommended procedures to be established by Owner for maintenance of landscape work for one full year. Submit before expiration of required maintenance period(s).

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants on projects of similar or larger scope.

1. Installer's Field Supervision: Maintain an experienced full-time super-visor on Project site when work is in progress.

A. Plant Material Inspection: Ship landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials. Provide nursery tags on plant material to certify that plant species comply with the Planting Schedule.

B. Plant Material Quality: Provide trees, shrubs, perennials, ornamental grasses, and groundcover of the quantity, size, genus, species, and variety indicated in the Planting Schedule and complying with ANSI Z60.1, where applicable. Provide healthy, vigorous nursery-grown plants, free of disease, insects, and physical defects.

C. 1. Where formal arrangements or consecutive plantings are shown, select plant material for uniform height and spread to provide a consistent appearance.

1. Where formal arrangements or consecutive order of trees or shrubs are shown, select stock for uniform height and spread, and label with number to assure symmetry in planting.

D. Topsoil: Existing topsoil will be stripped and stockpiled as specified in Section 31 11 000 "Site Clearing." In the event there is a shortage of topsoil to complete the work specified then the Contractor shall import topsoil at his expense. Quality of imported topsoil shall be as specified.

1. In the event there is a surplus of topsoil then the Contractor shall deposit and spread the topsoil where directed by the Architect. Excess topsoil shall not be removed from the site without authorization from the Owner.

1.6 DELIVERY, STORAGE AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Trees and Shrubs: Provide freshly dug balled and burlapped trees and shrubs. Do not prune prior to delivery unless otherwise approved by Architect. Do not bend or bind-tie trees or shrubs in such manner as to damage bark, break branches, or destroy natural shape. Provide protective covering during delivery and while at the project site. Do not drop plant stock during delivery and at the job site.

1.7 FIELD CONDITIONS

A. Planting shall be done within the following dates unless otherwise noted: September 15 to November 15 and March 15 to May 15. The Owner and landscape subcontractor may agree, in writing, to planting outside of these dates.

B. Utilities: All underground utility work shall be installed, inspected and approved before operations are started. Field verify utility locations prior to planting layout.

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions in accordance with manufacturer's written instructions and warranty requirements.

1.8 WARRANTY

A. Warrant trees, shrubs, perennials, ornamental grasses, groundcover, and other plant materials against defects, including death and unsatisfactory growth.

1. Warranty Period: 12 months from the Date of Substantial Completion.

B. During the warranty period, if the Contractor determines that maintenance practices or site conditions are detrimental to the health or growth of plant materials, the Contractor shall notify the Owner and Architect in writing, identifying the condition and recommending corrective action.

C. Remove and replace plant materials found to be dead or in an unhealthy condition during the warranty period. Make replacements during the next appropriate planting season.

D. Notify the Owner in writing at least 14 calendar days before expiration of the warranty period to arrange for a final inspection

E. Replace plant materials in doubtful condition at the end of the warranty period unless the Architect determines that an extension of the warranty for one full growing season is appropriate.

1.9 PLANT MATERIALS

A. General: Furnish nursery-grown trees, shrubs, and other plants of size, genus, species, variety and other features indicated in Planting Schedule indicated on the Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

B. Deciduous Trees: Provide trees of height and caliper scheduled or shown and with branching configuration recommended by ANSI Z60.1 for type and species required. Provide single stem trees except where special forms are shown or listed.

1. Provide balled and burlapped (B&B) deciduous trees. All burlap and twine shall be rottable.

C. Deciduous Shrubs: Provide shrubs of the height or spread shown or listed and with not less than minimum number of canes required by ANSI Z60.1 for type and height of shrub required.

1. Provide balled and burlapped (B&B) or container grown deciduous shrubs as indicated in the planting schedule. All burlap and twine shall be rottable.

D. Coniferous and Broadleafed Evergreens: Provide evergreens of sizes shown or listed. Dimensions indicate minimum spread for spreading and semi-spreading type evergreens and height for other types, such as globe, dwarf, cone, pyramidal, broad upright, and columnar. Provide normal quality evergreens, well balanced form, complying with requirements for other size relationships to the primary dimension shown.

1. Provide balled and burlapped (B&B) or container grown evergreen trees or shrubs as indicated in the planting schedule. All burlap and twine shall be rottable.

E. P**erennials and Ornamental Grasses:** Provide healthy, vigorous, container-grown plants of species, cultivar, size, and container size indicated in the Planting Schedule. Provide plants with well-developed root systems and growth characteristic of species and cultivar. Do not provide root-bound plants or plants with excessive circling roots.

F. **Groundcover:** Provide healthy, vigorous plants of species, cultivar, size, and container size indicated in the Planting Schedule, with well-developed root systems and free from weeds, disease, insects, and damaged or dead growth.

1.10 SOIL AMENDMENTS

A. Lime: Natural dolomitic limestone containing not less than 85 percent of total carbonates with a minimum of 30 percent magnesium carbonates, ground so that not less than 90 percent passes a 10-mesh sieve and not less than 50 percent passes a 100-mesh sieve.

B. Commercial Fertilizer: Complete fertilizer of neutral character, with some elements derived from organic sources and containing the following percentages of available plant nutrients:

1. For trees and shrubs, provide fertilizer with not less than 5 percent total nitrogen, 10 percent available phosphoric acid and 5 percent soluble potash.

C. Compost: Provide mature, stable, commercially produced compost consisting of decomposed leaf material, free of weed seeds, pathogens, and deleterious materials.

1. Compost shall be suitable for landscape planting and accompanied by laboratory analysis demonstrating its suitability.

2. Compost shall be thoroughly mixed with topsoil to provide a uniform planting soil mixture.

3. Incorporate compost at 20 percent by volume into topsoil for planting beds, unless otherwise indicated on the Drawings.

D. Planting Additive: Derived from Sea Kelp, Alfalfa Meal, Peat Humus, Poultry Manure, Iron Sulfate and Magnesium Sulfate and used to help prevent shock and minimize loss.

2. Product: dryROOTS®, or approved equal formula.
3. Guaranteed Analysis:

Total Nitrogen (N) 3.0%
2.0% Water Insoluble Nitrogen
1.0% Water Soluble Nitrogen
Available Phosphate (P_2O_5) 3.0% Soluble
Potash (K_2O) 3.0%
Calcium (C) 8.0%
Magnesium (Mg) 0.5%
Iron (Fe) 1.2%

1.11 MULCHES

A. Organic Mulch: Free from deleterious materials, noxious weed seeds and insect life and suitable for top dressing of trees, shrubs, or plants and consisting of the following:

1. Type: Double shredded, aged hardwoods, not decomposed.
2. Color: As selected by the Architect.

1.12 TREE STABILIZATION MATERIALS

A. Stakes and Guys: Rough-sawn, sound, new hardwood, treated softwood, or redwood, free of knots, holes and other defects, 2-by-2-inch nominal by length indicated.

B. Wire Ties and Guys: Provide 2-strand, twisted, pliable galvanized iron wire, not lighter than 12 gauge with zinc-coated turnbuckles.

1. Provide not less than 1/2-inch diameter rubber or plastic hose, cut to required lengths and of uniform color, material, and size to protect tree trunks from damage by wires.
2. Remove stakes and guys at the end of the Warranty Period by the Contractor.

PART 2 - EXECUTION

2.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material of liquid such as paint washout, concrete slurry, cement, oils, gasoline, asphalt, or roofing compound has been deposited in soil within planting area.
2. Confirm placed topsoil has been properly amended and prepared. This includes screening/removal of rocks and even incorporation of amendments.
3. Review surface grades and confirm proper grading has been completed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

2.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawn areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavation or planting. Make minor adjustments as required.

2.3 PREPARATION OF PLANTING SOIL

A. Screen and clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.

B. Mix specified soil amendments and fertilizers with topsoil at rates specified per soil test results prior to placing. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.

C. Planting soil for trees and shrubs shall consist of one (1) part organic matter to three (3) parts topsoil uniformly mixed.

D. Planting soil for trees and shrubs requiring acid soil shall consist of two (2) parts organic matter to three (3) parts topsoil uniformly mixed. Further amend soil as necessary to obtain a pH level of 5.0-5.5.

E. Mix fertilizer into planting soil at the rate of 0.25 pounds per cubic foot of soil or per rates specified by soil test results.

2.4 PREPARATION OF PLANTING BEDS

A. Loosen subgrade of planting bed areas to a minimum depth of 8 inches using a culti-mulcher or similar equipment. Remove stones measuring over 1-1/2 inches in any dimension. Remove sticks, stones, rubbish, and other extraneous matter.

B. Spread planting soil mixture to minimum depth required to meet lines, grades, and elevations shown, after light rolling and natural settlement. Place approximately one-half of total amount of planting soil required. Work into top of loosened subgrade to create a transition layer, place remainder of the planting soil.

C. Dig beds not less than 8 inches deep and mix with specified soil amendments and fertilizers.

D. Bermed (raised) planting beds shall be formed of all topsoil from top of the plant down to the level of adjoining seeded areas.

2.5 EXCAVATION FOR TREES AND SHRUBS

A. Excavate pits, beds, and trenches with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.

1. For trees, make excavations a minimum of 12 inches wider on each side than as the ball diameter and equal to the ball depth, plus following allowance for setting of ball on a layer of compacted backfill:

a. Allow for 3-inch thick setting layer of planting soil mixture.

2. For shrubs make excavation a minimum of 6 inches wider on each side than the ball diameter plus an allowance of 3 inches for setting of ball on a layer of compacted backfill.

B. Dispose of subsoil removed from planting excavations. Do not mix with planting soil or use as backfill.

2.6 PLANTING TREES AND SHRUBS

A. Set balled and burlapped (B&B) stock on layer of compacted planting soil mixture, plumb and in center of pit or trench with top of ball at same elevation as it was before transplanting. Remove burlap from top half of balls; retain on bottoms. Remove all twine entirely from plant root ball. Apply dryROOTS. When set, place additional backfill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately two-thirds full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill.

B. Dish top of backfill to allow for mulching.

C. Edge beds with 4-inch deep clean line wedge cut set 90 degrees adjacent to walks or lawn areas and 45 degrees toward planting bed.

D. Mulch pits, trenches, and planted areas. Provide not less than following thickness of mulch, and finish level with adjacent finish grades.

1. Provide 4-inch minimum, and 6-inch maximum thickness of mulch as top dressing. Dish top surface of the mulching to form a 4-inch high temporary "saucer" around each tree and shrub.
2. Keep mulch 2 inches away from plant stems or trunks.

E. Unless directed by the Architect, do not prune, thin out, or shape trees and shrubs.

F. Remove and replace excessively pruned or misformed stock resulting from improper pruning.

G. If directed by the Architect, guy and stake trees immediately after planting, with a minimum of 3 guys and stakes per tree, spaced at 120 degree intervals as per details on the Drawings.

H. If directed by the Architect, provide tree wrap on deciduous trees as indicated on the Drawings.

2.7 MAINTENANCE

A. Begin maintenance immediately after installation of each plant and continue through 90 days after Date of Substantial Completion.

B. Maintain trees, shrubs, perennials, ornamental grasses, and groundcover in a healthy, vigorous condition throughout the maintenance period.

C. Maintenance shall include watering, weeding, cultivating, pruning, resetting plants to proper grades or upright position, maintaining mulch at specified depth, tightening or repairing tree-stabilization materials, controlling insects and disease, and repairing settlement, erosion, or other damage to planting areas.

D. Provide sufficient water to maintain plants and planting soil in a healthy condition. Contractor shall provide labor, equipment, hoses, temporary connections, and other items required for watering during the maintenance period.

E. Remove and replace plants that die or become unhealthy or unacceptable during the maintenance period.

F. Maintain planting beds free of weeds, debris, and dead or damaged plant material.

2.8 CLEANUP AND PROTECTION

A. During landscape work, keep pavements clean and work area in an orderly condition.

B. Contractor shall be responsible for removing all trash and debris from the site daily. Site paving and curbs shall be broom cleaned and power washed at completion of all landscape work.

C. All removed trash and debris and legally disposed of, off-site by the Contractor.

D. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

2.9 INSPECTION AND ACCEPTANCE

A. Upon completion of planting work, request inspection by Architect to determine whether planting work is complete and acceptable.

B. Where inspected planting work does not comply with requirements, replace rejected work and continue required maintenance until reinspected and found acceptable.

C. Plant warranty period begins on Date of Substantial Completion. Contractor's plant-maintenance obligations shall continue through 90 days after Date of Substantial Completion.

D. At completion of the 90-day maintenance period, planting areas shall be healthy, weed-free, properly mulched, and in an acceptable condition. Correct deficiencies identified at final maintenance inspection.

END OF SECTION 32 93 00

SECTION 33 05 00 - COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping joining materials.
2. Transition fittings.
3. Dielectric fittings.
4. Sleeves.
5. Grout.
6. Piped utility demolition.
7. Piping system common requirements.
8. Equipment installation common requirements.
9. Concrete bases.
10. Metal supports and anchorages.

1.3 DEFINITIONS

A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.

B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

C. CPVC: Chlorinated polyvinyl chloride plastic.

D. HDPE: High Density Polyethylene plastic.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Dielectric fittings.
2. Identification devices.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.6 QUALITY ASSURANCE

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Steel Piping Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 COORDINATION

A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.

C. Coordinate size and location of concrete bases.

PART 2 - PRODUCTS

2.1 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D2235.
2. CPVC Piping: ASTM F493.
3. PVC Piping: ASTM D2564. Include primer according to ASTM F656.
4. PVC to ABS Piping Transition: ASTM D3138.

H. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.2 TRANSITION FITTINGS

A. Transition Fittings, General: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

B. Transition Couplings NPS 1-1/2 and Smaller:

1. Underground Piping: Manufactured piping coupling or specified piping system fitting.
2. Aboveground Piping: Specified piping system fitting.

C. AWWA Transition Couplings NPS 2 and Larger:

1. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.

D. Plastic-to-Metal Transition Fittings:

1. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint or threaded end.

E. Plastic-to-Metal Transition Unions:

1. Description: MSS SP-107, PVC four-part union. Include brass or stainless-steel threaded end, solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.

F. Flexible Transition Couplings for Underground Nonpressure Drainage Piping:

1. Description: ASTM C1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.3 DIELECTRIC FITTINGS

A. Dielectric Fittings, General: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

1. Description: Factory fabricated, union, NPS 2 and smaller.

a. Pressure Rating: 150 psig minimum at 180 deg F.
b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded ferrous.

C. Dielectric Flanges:

1. Description: Factory-fabricated, bolted, companion-flange assembly, NPS 2-1/2 to NPS 4 and larger.

a. Pressure Rating: 150 psig minimum.
b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:

1. Description: Nonconducting materials for field assembly of companion flanges, NPS 2-1/2 and larger.

a. Pressure Rating: 150 psig minimum.
b. Gasket: Neoprene or phenolic.
c. Bolt Sleeves: Phenolic or polyethylene.
d. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

1. Description: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining, NPS 3 and smaller.

a. Pressure Rating: 300 psig at 225 deg F.
b. End Connections: Threaded.

F. Dielectric Nipples:

1. Description: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining.

a. Pressure Rating: 300 psig at 225 deg F
b. End Connections: Threaded or grooved.

2.4 SLEEVES

A. Basis of Design Product: Omni Seal as manufactured bu SIGMA Corporation (www.sigmaco.com)

B. Sleeve shall be manufactured from ASTM A536 Ductile Iron with an integrally cast waterstop of 1/2” minimum thickness and 2-1/2” minimum height.

1. Sleeve body shall be manufactured from Ductile Iron
2. Sleeve seal shall be designed, manufactured and tested in strict accordance with applicable provisions of ANSI/AWWA C111/A21.11

C. Wall and/or floor pipe penetrations shall be made by a means of a sleeve capable of being bolted directly

to the formwork to prevent misalignment.

D. Seal of the annular space between the carrier pipe and the sleeve shall be by means of a confined rubber gasket and capable of withstanding 350psi.

2.5 GROUT

A. Description: ASTM C1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPED UTILITY DEMOLITION

A. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping. Fill abandoned piping with flowable fill, and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.
5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 DIELECTRIC FITTING APPLICATIONS

A. Wet Piping Systems: Connect piping of dissimilar metals with the following:

1. NPS 2 and Smaller: Dielectric or dielectric nipples.
2. NPS 2-1/2 to NPS 4: Dielectric nipples.
3. NPS 2-1/2 to NPS 8: Dielectric nipples or dielectric flange kits.
4. NPS 10 and NPS 12: Dielectric flange kits.

3.3 PIPING INSTALLATION

A. Install piping according to the following requirements and utilities Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination Drawings.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping to permit valve servicing.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Select system components with pressure rating equal to or greater than system operating pressure.

I. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs in accordance with manufacturer's written instructions.

J. Verify final equipment locations for roughing-in.

K. Refer to equipment specifications in other Sections for roughing-in requirements.

3.4 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and utilities Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

H. Soldered Joints: Apply ASTM B813 water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B32.

I. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

J. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.

K. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Pressure Piping: Join schedule number ASTM D1785, PVC pipe and PVC socket fittings

according to ASTM D2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D2855.

3. PVC Nonpressure Piping: Join according to ASTM D2855.

L. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D3139.

M. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D3212.

N. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D2657.

1. Plain-End PE Pipe and Fittings: Use butt fusion.
2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.

O. Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.5 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Install dielectric fittings at connections of dissimilar metal pipes.

3.6 EQUIPMENT INSTALLATION

A. Install equipment level and plumb, unless otherwise indicated.

B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.

C. Install equipment to allow right of way to piping systems installed at required slope.

3.7 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement .

3.8 GROUTING

A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 33 05 00

SECTION 33 30 00 - SANITARY SEWER UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 DESCRIPTION

A. This section specifies materials and procedures for construction of outside, underground sanitary sewer systems that are complete and ready for operation. This includes piping, structures and all other incidentals.

1.3 RELATED WORK

A. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 312000 “Earth Moving”.

1.4 ABBREVIATIONS

A. PVC: Polyvinyl chloride plastic

1.5 DELIVERY, STORAGE AND HANDLING

A. Store plastic piping protected from direct sunlight and support to prevent sagging and bending. Protect stored piping from moisture and dirt by elevating above grade. Protect flanges, fittings, and specialties from moisture and dirt.

B. Handle manholes according to manufacturer's written rigging instructions.

1.6 COORDINATION

A. Coordinate connection to sanitary sewer main with Public Utility company (Approval from public utility has been obtained indicating that the downstream sanitary systems have sufficient capacity to handle the sanitary discharge from the facility.)

B. Contractor to obtain approval from the Public Agency that the existing sanitary sewer systems have the capacity to handle the discharge from the facility.

C. Coordinate exterior utility lines and connections to building lines up to 5 feet of building wall.

D. Coordinate connection to public sewer system with Public Utility Company.

1.7 QUALITY ASSURANCE:

A. Products Criteria:

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to Public Sanitary Sewer lines and the extension, and/or modifications to Public Utility Systems.

1.8 SUBMITTALS:

A. Manufacturers' Literature and Data shall be submitted for the following as one package:

1. Pipe, Fittings, and, Appurtenances.
2. Jointing Material.
3. Manhole and Structure Material.
4. Frames and Covers.
5. Steps and Ladders.
6. Gate Valves.
7. Valve Boxes.

1.9 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

A74-09 .....Cast Iron Soil Pipe and Fittings

A185/A185M-07 .....Steel Welded Wire Reinforcement, Plain, for Concrete

A615/A615M-09b .....Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

A746-99 .....Ductile-Iron Gravity Sewer Pipe

C857-11 .....Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

C890-11 .....Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures

C913-08 .....Precast Concrete Water and Wastewater Structures

C923-08 .....Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

C990-09 .....Joints for Concrete Pipe, Manholes, and precast Box Sections using Preformed Flexible Joint Sealants

C1173-10 .....Flexible Transition Couplings for Underground Piping Systems

C1460-08 .....Shielded Transition Couplings for Use With Dissimilar DWV Pipe and Fittings Above Ground

D3034-08 .....Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

F477-10 .....Elastomeric Seals (Gaskets) for Joining Plastic Pipe

F679-08 .....Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings

F949-10 .....Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings

F1417-11 .....Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air F1668-

08 .....Construction Procedures for Buried Plastic Pipe

C. American Water Works Association (AWWA):

C105/A21.5-10.....Polyethylene Encasement for Ductile-Iron Pipe Systems

C110-08.....Ductile-Iron and Gray-Iron Fittings

C111/A21.11-06.....Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings

C151/A21.51-09.....Ductile Iron Pipe, Centrifugally Cast

C153/A21.53-06.....Ductile Iron Compact Fittings for Water Service

C219-11.....Bolted, Sleeve-Type Couplings for Plain-End Pipe

C600-10.....Installation of Ductile-Iron Mains and Their Appurtenances

C900-07.....Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution

D. American Society of Mechanical Engineers:

A112.14.1–2003.....Backwater Valves

A112.36.2M-1991.....Cleanouts

1.10 WARRANTY

A. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from final acceptance. Further, the Contractor will provide all manufacturers' and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

A. Standardization of components shall be maximized to reduce spare part requirements.

B. All pipe and fittings used in the construction of force mains shall be rated to meet the system maximum operating pressure with a minimum of 150 psi (1035 kPa).

C. The Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

2.2 PVC, GRAVITY SEWER PIPE

A. PVC Gravity Sewer Piping:

1. Pipe and Fittings shall conform to ASTM D3034 or ASTM F679, SDR 35, SDR 26.
2. Gaskets: ASTM F477.

B. Pressure Rating: 160 psi unless otherwise indicated.

1. Pipe shall be rated for surge pressures associated with pump station operation.

2.3 HDPE, PRESSURE SEWER PIPE

A. Pipe shall be High-Density Polyethylene (HDPE) meeting the requirements of:

1. ASTM F714, “Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.”
2. AWWA C906, “Polyethylene (PE) Pressure Pipe and Fittings, 4 in. through 65 in.” (latest revision).

B. Pipe material shall be manufactured from PE4710 resin.

C. Minimum cell classification per ASTM D3350: PE445574C or higher.

2.4 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C1173, elastomeric, sleeve type, reducing or transition coupling, for joining underground nonpressure piping. Include ends to match same sizes of main line piping and install corrosion-resistant metal tension bands and tightening mechanism on each end.

B. Sleeve Materials:

1. For Plastic Pipes: ASTM F477, elastomeric seal.
2. For Dissimilar Pipes: PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Couplings shall be elastomeric sleeve with stainless steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings:

1. Couplings shall meet ASTM C1460 with elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield with corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:

1. Couplings shall be elastomeric compression seal with dimensions to fit inside bell of larger mainline pipe and for spigot of smaller main line pipe to fit inside ring.

2.5 HDPE PRESSURE PIPE FITTINGS

A. Molded or fabricated HDPE fittings meeting AWWA C906

B. Backup rings:

1. Ductile iron: ASTM A536, epoxy coated
2. Drilling pattern per ANSI/AWWA C110/ C513

C. Transition Fittings & Appurtenances

1. Transition from HDPE to Ductile Iron/ Steel

a. Use manufacturer fabricated flanged adapters, MJ adapters, or compression couplings specifically listed for HDPE
b. Flange adapters shall comply with AWWA C207

D. Air Release Assemblies

1. ARV's shall be located as shown on drawings.

2.6 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Cleanouts shall be as per ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
2. Top-Loading Classification(s): Valve loadings shall be designed for Light Duty, Medium Duty, Heavy Duty, and Extra-Heavy Duty.
3. Cleanout Riser: Sewer pipe fitting on main line pipe and riser shall be as per ASTM A74,

B. PVC Cleanouts:

1. PVC body with PVC threaded plug: Cleanout shall be as per ASTM D3034. PVC sewer pipe fitting and riser to cleanout.
2. Cleanout Riser: Sewer pipe fitting on main line sewer and riser shall match main line piping.

2.7 MANHOLES

A. Standard precast concrete manholes and vaults detailed and constructed in accordance with PADOT specifications and details.

2.8 CONCRETE

A. Cast-in-place concrete shall be 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.

B. Reinforcement

1. Reinforcing fabric shall be ASTM A185, steel, welded wire fabric, plain.
2. Reinforcing bars shall be ASTM A615, Grade 60 (420 MPa) deformed steel.

C. Benches shall be concrete, sloped to drain into the channel. Provide 6 inches (150 mm) from the cut section of top of pipe to edge of manhole.

D. Ballast and Pipe Supports shall be Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water/cementitious materials ratio.

2.9 WARNING TAPE

A. Warning tape shall be standard, 4 mil (0.1 mm) polyethylene 3 inch (76 mm) wide tape detectable type, green with black letters and imprinted with “CAUTION BURIED SEWER LINE BELOW”.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify trench alignment, depth, bedding and subgrade conditions prior to installation.

B. Confirm that subgrade is stable, uniform and free of debris rock or organic material.

C. Verify that no conflicts exist with other utilities or structures.

D. Do not proceed until unsatisfactory condition are corrected.

3.2 HANDLING AND STORAGE

A. Handle piping to avoid gouging, kinking or bending.

B. Store pipe on level ground free from sharp stones and/ or debris.

C. Protect pipe from prolonged direct sunlight.

D. Do not drag pipe on ground.

3.3 PIPING INSTALLATION

A. Drawing plans and details indicate the general location and arrangement of underground sanitary sewer piping. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at the low point, true to grades and alignment indicated on the drawings, with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.

D. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.

E. Inspect pipes and fittings for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.

F. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.

G. Do not walk on pipe in trenches until covered by layers of bedding or backfill material to a depth of 12 inches (300 mm) over the crown of the pipe.

H. Warning tape shall be continuously placed 12 inches (300 mm) above sewer pipe

I. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

J. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

K. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process or microtunneling.

L. Install gravity-flow, non-pressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
2. Install piping with 36 inch (915 mm), 48 inch (1220 mm), 60 inch (1520 mm), 72 inch (1830 mm) - Insert number minimum cover as shown on Drawings.
3. Install ductile iron, gravity sewer piping according to AWWA C600.
4. Install PVC cellular-core, PVC corrugated sewer, PSM sewer and PVC gravity sewer according to ASTM D2321 and ASTM F1668.

M. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

N. Gravity Flow Lines with Secondary Containment (Encasement Pipe):

1. Install per manufacturer’s recommendations. Install all pipe centering devices to maintain an interstitial space below the invert of the carrier pipe. Both the carrier and containment pipe shall be tested for leaks.

3.4 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, non-pressure, drainage piping according to the following:

1. Join PVC piping according to ASTM D2321.
2. Join dissimilar pipe materials with nonpressure-type, flexible or rigid couplings.

B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use non-pressure flexible couplings where required to join gravity-flow, non-pressure sewer piping unless otherwise indicated.

    a. Unshielded, Shielded, Flexible, or Rigid couplings for pipes of same or slightly different OD.
    b. Unshielded, increaser/reducer-pattern, flexible or rigid couplings for pipes with different OD.
    c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure pipe couplings for force-main joints.

3.5 PRESSURE PIPE JOINT CONSTRUCTION

A. Perform butt fusion only by personnel certified with the last 12 months.

1. Fusion shall comply with ASTM F2620 and the pipe manufacturer’s fusion procedures.

2. Use only properly calibrated fusion equipment.

3. Fusion joints shall display:

4. Uniform bead roll-back

    a. No gaps, cracks or misalignment.
    b. Contractor shall maintain documentation to include:

        1) Date
        2) Time
        3) Pipe Size
        4) Ambient Temperature
        5) Technician

B. Installation of Fittings and Appurtenances

1. Install molded fittings, MJ adapters with torque- limiting tools and bolted per ANSI/ AWWA requirements

2. Provide concrete

3.6 SEWER AND MANHOLE SUPPORTS, CONCRETE CRADLES WITHIN VAULTS

A. Install reinforced concrete as detailed on the drawings. The concrete shall not restrict access for future maintenance of the joints within the piping system.

3.7 BUILDING SERVICE LINES

A. Install sanitary sewer service lines to point of connection within approximately 5 feet outside of building(s) where service is required and make connections. Coordinate the invert and location of the service line with the Contractor installing the building lines.

3.8 MANHOLE INSTALLATION

A. Install manholes complete with appurtenances and accessories indicated.

1. Precast concrete segmental blocks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 1/2 inch (15 mm) or cement mortar applied with a trowel and finished to an even glazed surface.
2. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top, shall be sealed as per manufacturer’s

recommendations. Adjust the length of the rings so that the top section will be at the required elevation. Cutting the top section is not acceptable.

3. Concrete manhole risers and tops: Install as specified.

B. Designed Concrete Structures:

1. Do not build structures when air temperature is 32 deg F (0 deg C), or below.

C. The wall that supports access rungs or ladder shall be 90 deg vertical from the floor of structure to manhole cover.

D. Install steps and ladders per the manufacturer's recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.

E. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. In unpaved areas, the rim elevation shall be 2 inches (50 mm) above the adjacent finish grade.

F. Install manhole frames and covers on a mortar bed, such that frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. Install an 8 inches (200 mm) thick, by 12 inches (300 mm) wide concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.9 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade per the IPC and the project plans and details.

1. Cleanouts should be 6 inches (150 mm) in diameter and consist of a ductile iron 45 degree fitting on end of run, or combination Y fitting and l/8 bend in the run with ductile iron pipe extension, water tight plug or cap and cast frame and cover flush with finished grade. Install piping so cleanouts open in direction of flow in sewer pipe.
2. Use Heavy-Duty, top-loading classification cleanouts.
3. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.

B. Set cleanout frames and covers in earth in cast-in-place-concrete, 18 by 18 by 12 inches (450 by 450 by 300 mm) 1 inch (25 mm) above surrounding grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

D. The top of the cleanout assembly shall be 2 inches (50 mm) below the bottom of the cover to prevent loads being transferred from the frame and cover to the piping.

3.10 CONNECTIONS

A. Make connections to existing piping and underground manholes by coring and installing the pipe at the design invert. Install an elastomeric gasket around the pipe, and grout the interstitial space between the pipe and the core.

B. Connection to an existing manhole: The bench of the manhole shall be cleaned and reshaped to provide a smooth flowline for all new pipes connected to the manhole.

C. Use commercially manufactured wye fittings for piping branch connections. Encase entire wye fitting plus 6-inch (150-mm) overlap with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).

1. Make branch connections from the side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500), by removing a section of the existing pipe.
2. Make branch connections from the side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes by cutting an opening into existing unit large enough to allow 3 inches (76 mm) of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in concrete

to provide additional support of collar from connection to undisturbed ground.

3. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.11 REGRADING

A. Raise or lower existing manholes and structures frames and covers, cleanout frames and covers and valve boxes in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Adjust the elevation of the cleanout pipe riser, and reinstall the cap or plug. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.

B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.

3.12 CLOSING ABANDONED SANITARY SEWER SYSTEMS

A. Close open ends of abandoned underground piping indicated to remain in place in accordance with the recommendations of the Geotechnical report. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed.

1. Piping under and within 5 feet (1500 mm) of building areas shall be completely removed.
2. Piping outside of building areas shall be completely removed plugged with concrete, and abandoned in-place.

3.13 PIPE SEPARATION

A. Horizontal Separation - Water Mains and Sewers:

1. Existing and proposed water mains shall be at least 10 feet (3 m) horizontally from any proposed gravity flow and pressure (force main) sanitary sewer or sewer service connection.

2. Gravity flow mains and pressure (force) mains may be located closer than 10 feet (3 m) but not closer than 6 feet (1.8 m) to a water main when:

   a. Local conditions prevent a lateral separation of 10 feet (3 m); and
   b. The water main invert is at least 18 inches (450 mm) above the crown of the gravity sewer or 24 inches (600 mm) above the crown of the pressure (force) main; and the water main is in a separate trench separated by undisturbed earth.

3. When it is impossible to meet (1) or (2) above, both the water main and sanitary sewer main shall be constructed of push-on or mechanical joint ductile iron pipe.

B. Vertical Separation - Water Mains and Sewers at Crossings:

1. Water mains shall be separated from sewer mains so that the invert of the water main is a minimum of 24 inches (600 mm) above the crown of gravity flow sewer or 48 inches (1200 mm) above the crown of pressure (force) mains. The vertical separation shall be maintained within 10 feet (3 m) horizontally of the sewer and water crossing. When these vertical separations are met, no additional protection is required.
2. In no case shall pressure (force) sanitary main cross above, or within 24 inches (600 mm) of water lines.
3. When it is impossible to meet (1) above, the gravity flow sewer may be installed 18 inches (450 mm) above or 12 inches (300 mm) below the water main, provided that both the water main and sewer shall be constructed of push-on or mechanical ductile pipe. Pressure (Force) sewers may be installed 24 inches (600 mm) below the water line provided both the water line and sewer line are constructed of ductile iron pipe.

4. The required vertical separation between the sewer and the water main shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer line is at least 10 feet (3 m).

3.14 IDENTIFICATION

A. Install green warning tape directly over piping and at outside edges of underground manholes.

3.15 FIELD QUALITY CONTROL

A. All systems shall be inspected and obtain the Authority having Jurisdiction's approval. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.

B. To inspect, thoroughly flush out the lines and manholes before inspection. Lamp test between structures and show full bore indicating sewer is true to line and grade. Lips at joints on the inside of gravity sewer lines are not acceptable.

1. Submit separate report for each system inspection.
2. Defects requiring correction include the following:

   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Re-inspect and repeat procedure until results are satisfactory.

C. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

1. Test plastic gravity sewer piping according to ASTM F1417.
2. Test concrete gravity sewer piping according to ASTM C924.
3. Clean and isolate the section of sewer line to be tested. Plug or cap the ends of all branches, laterals, tees, wyes, and stubs to be included in the test to prevent air leakage. The line shall be pressurized to 4 psi (28 kPa) and allowed to stabilize. After pressure stabilization, the pressure shall be dropped to 3.5 psi (24 kPa) greater than the average back-pressure of any groundwater above the sewer.

D. Hydrostatic pressure testing

1. Conduct pressure testing in accordance with referenced standards and as follows:

   a. Fill pipeline slowly to remove trapped air.
   b. Test pressure: 1.5 × operating pressure unless otherwise noted.
   c. Test duration: Minimum 2 hours.

2. Allow pipe to stabilize for a minimum of 2 hours before testing.
3. Isolate HDPE joints from non-HDPE materials during testing where possible.
4. Record pressure readings at start, at 10-minute intervals, and at completion.
5. Test is considered acceptable when no pressure loss occurs outside allowable values.

3.16 DISINFECTION & FLUSHING

A. Flush line at high velocity to remove debris prior to acceptance.

B. Where required by engineer, treat line with a chlorine or disinfecting agent.

3.17 CLEANING

A. Clean dirt and superfluous material from interior of piping.

END OF SECTION 33 30 00

SECTION 33 41 00 – STORM DRAINAGE SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes, but is not limited to, the following:

1. Storm water piping.
2. Manholes.
3. Inlets, outlet structures, and catch basins.
4. Flared end sections for HDPE pipe.

B. Related Requirements:

1. Section 033020 “Concrete Work for Utilities” for concrete materials.

1.3 SUBMITTALS

A. Product Data: For each type of product.

1. Include technical product data and installation instructions for all storm sewage system materials and products.

B. Shop Drawings: For the following:

1. Manholes: Include plans, elevations, sections, details, and frames and covers.
2. Catch Basins, Outlet Structures, Flared End Sections, etc.:

a. Include plans, elevations, sections, details, and frames, covers, and grates.

C. Product Certificates: Signed by the manufacturer of high density polyethylene pipe stating the product was manufactured, tested, and supplied in accordance with all applicable requirements of AASHTO M-252 (or AASHTO M-294 as applicable), ASTM F477 and ASTM D3212.

D. Maintenance Data: Submit maintenance data and parts lists for storm sewage system materials and products.

1. Include product data, shop drawings, and record drawings in maintenance manual in accordance with requirements of Division 1.

1.4 QUALITY ASSURANCE

A. Codes and Standards: All work shall be performed in accordance with methods and details indicated on the plans, local township standards, PennDOT Publication 408 Specifications, current edition and all regulatory bodies having jurisdiction on this work.

B. Environmental Compliance: Comply with applicable portions of respective County Conservation District regulations pertaining to storm sewage systems.

1.5 FIELD CONDITIONS

A. Site Information: Perform complete site review and investigation, research public utility records, and verify existing utility locations. Contact utility-locating service for area where project is located.

B. Locate existing structures and piping to be removed, closed, or abandoned where required.

C. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by Owner or others except when permitted under the following conditions and then only after arranging to provide acceptable temporary utility services.

1. Notify the utility owner not less than 72 hours in advance of any proposed utility interruptions.
2. Do not proceed with utility interruptions without receiving the jurisdictional authority's written permission.

PART 2 - PRODUCTS

2.1 CORRUGATED HIGH DENSITY POLYETHYLENE STORM SEWER PIPE

A. Materials: Pipes, couplings, and fittings shall be made of polyethylene compounds, and shall meet requirements of ASTM F2306 and ASTM F2648 and AASHTO M-252 and M-294 current edition. Bends, tees, wyes, flared end sections, etc. will be standard fabricated fittings. Pipes and fittings shall be free of foreign inclusions and visible defects.

1. Storm Water Pipe: Smooth lined corrugated Pipe.
2. Single-Wall Pipe: Underdrain piping shall meet requirements of AASHTO Type C pipe for single-wall pipe.
3. Pipe Stiffness: Pipe size as indicated below shall have minimum pipe stiffness at five percent deflection when tested in accordance with the requirements of ASTM D2412:

Diameter (inches)	Pipe Stiffness (psi)
8	50
12	50
15	42
18	40
24	34
30	28
36	22
42	19
48	17

B. Joint System: Joints for all pipe and fittings shall use gasketed, watertight bell/spigot couplers. The gaskets shall meet the requirements of ASTM F477 and the joint system shall be certified to meet ASTM D3212.

1. Joint system shall provide sufficient longitudinal strength to preserve pipe alignment and prevent separation at the joint.

2.2 POLYVINYLCHLORIDE (PVC) PIPE

A. Material: Pipe and fittings shall comply with ASTM D3034 for SDR-35 sewer pipe. All pipe shall be made from PVC resin, compounded to provide physical and mechanical properties that equal or exceed cell class 12454 or 12364 as defined in ASTM D1784.

1. Fittings: ASTM D3034, PVC with bell ends.
2. Gaskets: ASTM F477, elastomeric seals.

B. Fittings and Joints: All fittings and accessories shall be furnished by the pipe manufacturer and have bell and/or spigot configurations compatible with that of the pipe.

1. The bell shall consist of an integral wall section with a solid cross section of elastomeric gasket complying with ASTM F477. Gaskets shall be factory assembled and securely locked in place to prevent displacement during assembly.
2. Joint design shall comply with ASTM D3212.

2.3 REINFORCED CONCRETE PIPE

A. Material: Pipe shall be Class III or Class IV as indicated, reinforced concrete pipe, AASHTO M 170, in accordance with ASTM C76. All reinforced concrete pipe shall be stamped with:

1. The name or trademark of the manufacturer.
2. The pipe class, type of wall, and size of pipe.
3. The date of manufacture.

B. Joints: Bell-spigot rubber gasketed joint type complying with Standard Specification ASTM C443.

C. Mortar: Mortar for lift holes shall be composed of materials designated under the concrete specifications. Mortar shall be used within forty-five (45) minutes subsequent to mixing. Mortar that has stiffened shall not be remixed and used.

2.4 PRECAST CONCRETE STRUCTURES

A. Portland cement shall conform to ASTM C150 with aggregates conforming to ASTM C 33. Minimum compressive strength shall be 3,750 PSI. Water-cement ratio shall be 0.45. The minimum cement content shall be 564 lb./cy. Cement shall be Type I, IA, II, IIA, III, or IIIA. The air content shall be 6±1%. Air-entraining admixtures shall meet the requirements of ASTM C260.

B. Reinforcing steel shall conform to ASTM A615 grade 60 for bars or ASTM A185 for welded wire fabric.

2.5 INLETS, CATCH BASINS AND OUTLET STRUCTURES

A. General: The Contractor shall provide precast inlets and outlet structures at the locations and to the dimensions and elevations shown on the drawings. The inlets shall be the type inlets indicated on the drawings and constructed as specified by the local township standard construction details, PennDOT Standard Construction Details, and PennDOT RC-standards, latest edition.

1. Included shall be all necessary excavation, precast concrete sections, steps, gaskets, brick masonry, frame and grate, concrete flow channels, backfilling and all necessary appurtenances for completion.
2. Include all weepholes indicated on inlets to provide sub-surface drainage from adjoining areas.

B. Materials: Materials for the inlets shall conform to the following PennDOT Specification Publication 408 Sections, latest edition, as amended.

1. Minimum Class AA Concrete - Section 704.1. Concrete shall be air entrained.
2. Reinforcement - Sections 709.1 and 709.3.
3. Structural Steel - Section 1052.01 (Form 409).
4. Mortar - Section 705.7.
5. Precast Cement Concrete Units - Section 713.2.

C. Frame and Grates: Frames shall be grey, malleable or ductile-iron castings or structural steel. Structural steel grates shall be used on basin outlet structures and structural steel bicycle-safe grates for all inlet boxes. Coat frames and grates with bituminous paint.

1. Refer to Civil Drawings for additional detail information for Type ‘C’ and Type ‘M’ inlet

frames and grates and “Trout Logo Plate” designs.

D. Steps: Construct steps in inlets that exceed five (5) feet in height. Step material shall be aluminum alloy 6005-T5 or 6061-T6 extrusions.

2.6 MANHOLES

A. Precast Manholes: Conform to local township standard construction details, PennDOT Publication #72M, RC-39M, latest edition and ASTM C478 for "Specifications for Precast Reinforced Concrete Manhole Sections." Concrete shall be air-entrained. Form flow channels in bases.

1. Masonry Mortar: Conform to ASTM C270.

B. Frames and Covers: Conform to local township standard cast iron storm sewer manhole frame and cover, and PennDOT Publication #72M, RC-39M, latest edition. Frames and covers shall be heavy duty AASHTO Highway Loading Class HS-25. Covers shall have wording and image in scripted design with raised letters and have two pick holes as detailed on the Civil Drawings. Coat frames and covers with bituminous paint.

C. Manhole Steps: Construct steps in manholes that exceed five feet in height. Steps shall be copolymer polypropylene plastic with 1/2-inch grade 60 steel reinforcement bar.

2.7 AREA DRAINS

A. Materials: Provide precast reinforced concrete area drain (inlet box) assembly consisting of 2’-0” by 2’-0” (inside dimension) drain basin or approved equal.

B. Grate: Manufacturers standard Type “M” bicycle safe grate on square flange attached to concrete box as indicated on the Civil Drawings.

2.8 IN-LINE AREA DRAIN

A. Riser and Drain Basin: PVC as indicated.

B. Grate: Ductile Iron

2.9 CLEANOUTS

A. Cleanouts: Manufacturer’s standard cast iron frame and cover. PVC sewer pipe fitting and riser to cleanout shall be size and material as indicated on the Civil Drawings.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the work include, but are not limited to, the following:

a. EJ Group, Inc.; Model No. 1566.

2.10 CONCRETE WORK

A. Class AA Concrete:

1. 28 Day Compressive Strength: 3750 psi.
2. Slump: 1 to 3 inches.
3. Use for all precast concrete.

B. Class A Concrete:

1. 28 Day Compressive Strength: 3300 psi.

2. Slump: 1 to 3 inches.
3. Use for all site cast concrete.

C. Cement factor and maximum water/cement ratio shall conform to PennDOT 408 Specification Table A, Section 704.1 (b).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. No pipe shall be laid on frozen or thawing material or during wet weather conditions. Each pipe shall be subject to observation by the Architect, and those not meeting the specified requirements shall be removed from the work site. Delivery slips from the pipe suppliers shall be kept on the work site and furnished, upon request, to the Architect.

1. Architect shall have the right to make changes in the line and grade of all storm sewers as may be necessary or advantageous.

B. Lay pipe proceeding upgrade with the bell or groove pointing upstream.

C. Line and Grade Checks: The Contractor shall check each section of pipe from the string line and grade board or other approved methods. A variation of one quarter (1/4) inch or more from the true invert grade and a variation of one (1) inch or more from the true line will be sufficient reason for the Architect to order the work to be rejected.

3.2 PIPE LAYING

A. Pipe shall be installed as per notes and details of the Civil Drawings and in accordance with the requirements of PennDOT Specifications, ASTM D2321, or manufacturer's written instructions. The Contractor should be aware that for different sizes of pipe different requirements shall govern. All connections shall be assembled in accordance with the manufacturer's recommendations to produce secure, tight joints.

B. All pipe shall be laid and maintained to the required lines and grades shown on the Contract Drawings.

C. Following the trench preparation, pipe laying shall proceed from the downgrade end. Pipe ends shall be carefully cleaned before pipes are lowered into the trench.

D. Each section of pipe shall be placed so that the full length of its barrel rests on six inches of bedding material. Each section of pipe shall be firmly held in position so that its invert forms a continuous grade with the invert of the previously laid pipe.

E. Polyethylene (HDPE) Pipe and Fittings:

1. Install piping according to ASTM D2321 and manufacturer's written instructions.
2. Join pipe and fittings with couplings for watertight joints according to AASHTO "Standard Specifications for Highway Bridges", Division II, Section 26.4.2.4 "Joint Properties"; or ASTM D2321; and manufacturer's written instructions.

F. Polyvinyl Chloride (PVC) Pipe and Fittings:

1. Install piping in accordance with ASTM D2321 and manufacturer's written instructions.
2. Push-On Joints: Assemble joints fabricated in accordance with manufacturer's written instructions. Joints shall be tested in accordance with ASTM D3212.

a. Mark or verify that pipe ends are marked to indicate insertion stop position, and insure that pipe is inserted into fitted bells to this mark. Push spigot into bell using methods recommended by the manufacturer.

3. Coupled Joints: In accordance with manufacturer's written instructions.

G. Concrete Pipe Joints: Joints in reinforced concrete piping shall be assembled in accordance with the manufacturer's specifications using gasketed joints.

H. The end of the pipe shall be protected with a stopper to prevent the entrance of water, earth, stones, or other debris. Any debris entering the pipe shall be removed immediately to the satisfaction of the Architect.

I. Walking or working on the completed pipe line, except as may be necessary in tamping or backfilling, shall not be permitted until the trench has been backfilled to a height of at least eighteen inches over the top of the pipes.

J. Storm sewer pipe that has its grade or joints disturbed after laying shall be taken up and relaid. Any section of pipe already laid and found to be defective shall be taken up and replaced with new pipe by the Contractor.

K. At manholes and inlet and outlet structures, the pipe shall be installed with watertight penetrations.

3.3 INLETS, CATCH BASINS OUTLET STRUCTURES, AND MANHOLES

A. All structures shall conform to the lines and grades given, and to the dimensions and design as indicated on the Civil Drawings.

B. Inlets, catch basin structures, manholes, etc. shall be constructed using precast units. All reinforcing shall conform to PennDOT Standard Construction Details, DWG. RC-34.

C. Cement concrete construction shall comply with the applicable requirements of PennDOT Specifications Publication 408 Section 713, and shall be air entrained concrete.

D. Masonry construction shall comply with the applicable requirements of PennDOT Specifications Publication 408 Section 713.

E. Inlets shall be constructed in accordance with the requirements specified in PennDOT Specifications Publication 408, Section 605, RC 34 and plan details.

F. The pipes in inlets shall be flush with the inside face of the structure.

G. Spaces excavated for but not occupied by these structures, shall be backfilled with acceptable material in uniform loose layers not exceeding four (4) inches in depth, and be compacted by means of approved mechanical tampers.

3.4 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from storm sewer pipes to cleanouts at grade. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Set cleanout frames and covers in earth in cast-in-place concrete collar as detailed on the drawings.
2. Set cleanout frames and covers in asphalt and/or concrete pavement with tops flush with pavement surface.

3.5 FIELD QUALITY CONTROL

A. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.

B. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 33 41 00