

March 28, 2025 – BID ISSUE

# TREDYFFRIN EASTTOWN SCHOOL DISTRICT NEW ELEMENTARY SCHOOL

1200 W. Swedesford Road  
Berwyn, Pennsylvania 19312

For the Tredyffrin / Easttown School District  
940 West Valley Road, Suite 1700, Wayne, Pennsylvania, 19087 t 620 240 1900

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## SPECIFICATIONS

HSA Project No. 23-037

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### Schiller & Hersh Associates, Inc.

Consulting M/E/P/FP Engineers

636 Skippack Pike, Suite 200, Blue Bell, Pennsylvania 19422

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### Pennoni Associates, Inc

Consulting Site Civil Engineers

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t 610 429 8907

### A.W. Lookup Corporation

Structural Engineers

500 Fayette Street, Suite 100, Conshohocken, Pennsylvania 19428

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Heckendorn Shiles Architects

Architect

347 E Conestoga Rd, Wayne, Pennsylvania 19087

t 610 994 3500

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APPENDICES

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## NOTICE TO BIDDERS

NEW ELEMENTARY SCHOOL at 1200 W. Swedesford Road for **the Tredyffrin/Easttown School District**

Bids will be received electronically before **10:00 A.M., Monday, June 9, 2025, at which time the bids will be opened on the PennBid website with results displayed publicly.** The results will be also read aloud at the offices of the Purchasing Department, Tredyffrin/Easttown School District, Administration Offices, 940 W Valley Road, Suite 1700 Wayne, PA 19087.

<b>Contract</b>	<b>Proposal Guaranty</b>
General Construction	10%
Electrical Construction	10%
Plumbing Construction	10%
Mechanical Construction	10%

Sets of Plans, Specifications, and other documents constituting the Contract Documents may be obtained at no cost on the PennBid website, [www.PennBid.net](http://www.PennBid.net). Plans and specifications will be available **March 28, 2025**.

Each proposal must be accompanied by a proposal guaranty, in the amount above stipulated, in the form of a certified check, bank cashier's check, trust company treasurer's check or a bid bond, in the form prescribed in the Contract Documents, with satisfactory corporate surety authorized to do business in Pennsylvania, naming as payee (or obligee as applicable) the Tredyffrin/Easttown School District.

Acceptance by the Owner of the successful bidder's proposal shall be in the form of a contingent Notice of Award. Upon receipt of such Notice of Award, the successful bidder must furnish, 1) Contract Bonds in the forms prescribed in the Contract Documents; 2) evidence of required insurance as detailed in the Contract Documents; and 3) a signed and notarized Form of Agreement in the form provided in the Contract Documents, all prior to receiving a Notice to Proceed.

Proposals must be submitted electronically via the PennBid website.

Except as expressly provided for in these specifications, no proposals may be withdrawn for a period of sixty (60) days after the date specified for receiving, opening, and reading of proposals.

The time allowed for completion shall be as set forth in the Contract Documents. All Contracts will start immediately.

The Tredyffrin/Easttown School District reserves the right to reject any or all proposals or parts thereof or items therein and to waive any defects or irregularities in proposals.

A mandatory Pre-Bid Meeting (project walk-through) will be held on **Thursday, April 3, 2025, at 9:00 A.M.** at 1200 W. Swedesford Road, Berwyn, PA 19312.

**Contractors who do not attend the mandatory pre-bid meeting will not be permitted to submit bids.**

Tredyffrin/Easttown School District  
Arthur J. McDonnell  
Business Manager

Heckendorn Shiles Architects  
Matthew A Heckendorn  
Principal



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## INSTRUCTIONS TO BIDDERS

### NEW ELEMENTARY SCHOOL; 1200 W. SWEDESFORD ROAD

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SECTION 29	- CASH ALLOWANCES
SECTION 30	- PENNSYLVANIA SALES TAX EXEMPTION
SECTION 31	- DISCRIMINATION PROHIBITED
SECTION 32	- FEDERAL REQUIREMENTS
SECTION 33	- HVAC – COORDINATION WITH CONTROLS SUBCONTRACTOR

#### SECTION 1 - RECEIVING, OPENING, AND READING OF PROPOSALS

- A. Proposals will be received for the following project:

##### **New elementary school; 1200 W. Swedesford Road**

by the Tredyffrin/Easttown School District, at the Administration Office, 940 West Valley Road, Suite 1700, Wayne, PA 19087.

Proposals will be accepted up to **10:00 am, Monday June 9, 2025.**

The bids will be unsealed electronically via the PennBid website, and also will be read aloud at **10:00 am, June 9, 2025.**

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- B. Sealed proposals will be received for the following contracts:

**General Construction:** This proposal will include all labor, equipment and materials to complete all of the General Construction work contained in the Contract Documents. The General Contractor shall also be responsible as the Prime Coordinator on this project. In that role, he shall be responsible to coordinate activities of all Prime Contractors so that the construction schedule is maintained. See also specification Section 01041.

**Plumbing Construction:** This proposal will include all labor, equipment and materials to complete all of the Plumbing and Sprinkler Fire Protection Construction work contained in the Contract Documents.

**Electrical Construction:** This proposal will include all labor, equipment and materials to complete all of the Electrical Construction work contained in the Contract Documents.

**Mechanical Construction:** This proposal will include all labor, equipment and materials to complete all of the Mechanical Construction work contained in the Contract Documents.

- C. A **mandatory Pre-Bid Meeting** (project walk-through) will be held on **Thursday, April 3, 2025, at 9:00 A.M.** at 1200 W. Swedesford Road, Berwyn, PA 19312.
- D. Contractors will be responsible for notifying the Owner/Architect, before bids are submitted, of any discrepancies in the Drawings and/or Contract Documents which would require additional work not included in the base bid or alternate descriptions. Contractors' bids are an affirmative statement by the contractors that any and all questions or discrepancies have been addressed to the contractors' satisfaction pursuant to the terms of Section 10 of these Instructions to Bidders.
1. Questions, substitution requests, and requests for clarification or interpretations of the Bid Documents shall be made in writing and must be submitted by **4:00pm, Friday, April 18, 2025.**

## SECTION 2 - PREPARATION OF PROPOSALS

- A. Bound herewith is a complete set of bidding forms and Contract Documents. Any Addenda or Bulletins which are promulgated prior to the bid due date shall also be made part of the Contract Documents.
- B. No proposal will be considered, which is submitted other than upon the Bid Form through PennBid.
- C. The Bidder shall sign and complete the proposal properly in accordance with the following:
1. If the Bidder is an individual, the proposal shall be executed by such individual, personally, such individual's signature shall be witnessed, such individual's business address and phone number shall be stated, and any trade name employed in the conduct of such individual's business shall be stated.
  2. If the Bidder is a corporation, the proposal shall be executed in its name and in its behalf: 1) by the President or a Vice-President and attested by the Secretary or an Assistant Secretary and the corporate seal shall be attached; or 2) by a duly authorized agent of the corporation whose authority to act, as of the date of the proposal, shall be established by proof, in a form satisfactory to the Owner, submitted with the proposal. The business address of the corporation shall be stated, the state of incorporation shall be stated, and, if the corporation is a foreign corporation, whether the corporations is registered to do business in Pennsylvania shall be stated.
  3. If the Bidder is a partnership, the proposal shall be executed and sealed in the name of the partnership, followed by the signature of a general partner, together with a certification from each general partner that the general partner executing the proposal has been authorized by the partnership to execute and deliver the bid. The business address of the partnership shall be stated,

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the state of registration shall be stated, if any, and any trade name employed by the partnership in the conduct of its business shall be stated.

- D. All blank spaces in the Bid Form (as incorporated on PennBid) shall be completed. All amounts stated in the proposal shall be stated. Failure to complete all blank spaces in the Bid Form renders such a bid incomplete and such a bid may be rejected by the Owner as non-responsive.
- E. Each proposal shall be based upon the plans, Specifications, and other documents constituting the Contract Documents referred to in the Notice to Bidders bound herewith, including related drawings, bulletins, and addenda.
  - 1. Any proposal which contains omissions, additions, or deductions not called for or permitted, alterations of form, conditional of uninvited alternate proposals or irregularities of any kind, and any proposal which is not based upon the documents referred to in the preceding paragraph. Furthermore any proposal which, while otherwise regular in form, shall not be accompanied by the proper proposal guaranty as set forth in Section 4, may be rejected by the Owner as being informal.
  - 2. The Owner may reject any proposal in which prices are obviously unrealistic.
- F. Proposals shall not contain any recapitulations of the work to be performed.
- G. Erasures, alterations, or changes made by the Bidder in the completion of the proposal shall be explained or noted appropriately with the signature of the Bidder. These proposals may, at the discretion of the Owner, be rejected.
- H. Attached in the specifications is a copy of the AIA Contractors Qualification Statement. This statement must be completed for each **Contractor**. It will be required that the Contractor retain craftsmen skilled to perform the work.
  - 1. Each Prime Contractor must have been in business for at least five years.
  - 2. Each Prime Contractor must have successfully completed at least four comparable size projects in the past five years. The Contractor must have proven experience doing similar type facilities.
- J. All contractors are required to have an 'A-' (A minus) or better bond rating at the time of the bid submission, as determined by AM Best.

### **SECTION 3 - SUBMISSIONS OF PROPOSALS**

- A. Each proposal, accompanied by proposal guaranty as set forth in Section 4, shall be submitted electronically via PennBid.

### **SECTION 4 - PROPOSAL GUARANTY**

- A. Each proposal must be accompanied by the proposal guaranty, in the amount of ten (10%) percent of the greatest possible contract amount. The proposal guaranty shall be in the form of a certified check, bank cashier's check, trust company's treasurer's check or a bid bond, in the form bound herewith, with corporate surety authorized to do business in Pennsylvania and satisfactory to the Owner. The proposal guaranty shall name the Owner as payee or obligee, as applicable.
- B. The form of Bid Bond is furnished herewith for the use of the Bidder. In the event that a bid bond is submitted with the proposal, the Bidder shall make certain that a proper power of attorney evidencing the authority of the agent of the surety to execute the bid bond is submitted therewith.

Proposal guaranty shall be submitted upon the understanding that the same shall guarantee that if a Bidder, to whom ten (10) calendar days' notice of intention to accept such Bidder's proposal has been made by or on behalf of the Owner, fails to furnish a performance bond and a payment bond in the forms furnished

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herewith to the Owner, as are required by the law of the Commonwealth of Pennsylvania, as a condition precedent to formal award of the contract and fails to execute the Agreement or to furnish the required insurance certificates within ten (10) days after notice that an award has been made to such Bidder, the Owner may, in its sole discretion, declare the Bidder to be in default with respect to such Bidder's proposal.

1. In the event that any Bidder shall be declared to be in default with respect to such Bidder's proposal, as provided for above, the Owner may declare such proposal guaranty to be forfeited to the Owner as liquidated damages.
  2. With respect to the discovery of inaccurate or incomplete information provided in the Bidder's proposal documents, the Owner shall have the right to declare the Bidder's proposal to be in default, even if the 60 day period, beyond the date for opening of bids for acceptance of the Bidder's proposal, has lapsed. In the event of such default, the Owner shall also have the right to retain the defaulted Bidder's Bid Bond. See also, Section 6 in these Instructions to Bidders.
- C. The proposal guaranty accompanying the proposal, of all Bidders of each contract who have submitted acceptable bids, will be held by the Owner until two days following the execution of an agreement with the successful Bidder. If the Owner decides that no award will be made, then the proposal guaranty will be returned two days following the decision. In any event, the proposal guaranty need not remain valid beyond a point two days after the expiration date for the proposal.
- D. The Owner shall not be liable for interest upon the proposal guaranty accompanying any proposal, which is in the form of a check, for the period during which such proposal guaranty is held under Section 4.
- E. The proposal shall hold good for sixty days from the date of submission of bids.
- F. If contractor submits a bid on more than one prime contract, separate proposal guaranties are required for each prime contract.

#### **SECTION 5 - WITHDRAWAL OF BIDS**

- A. Any Bidder may, in writing, withdraw such Bidder's proposal within two (2) business days after the opening of bids and in accordance with the Title 73 PS 1602.

#### **SECTION 6 - AWARD OF CONTRACT OR REJECTION OF PROPOSALS**

- A. An award by the Owner, if made, will be made to the lowest responsible Bidder within sixty (60) days after the opening of the bids or as defined in Title 73 PS 1622.
- B. The Owner reserves the right to reject any or all proposals or parts thereof or items therein and to waive any defects or irregularities in proposals.
- C. The Owner reserves the right to consider such matters, facts, and circumstances as shall be permitted by Pennsylvania law in making a determination of whether a Bidder is a responsible Bidder.
- D. The Owner, before making an award, may require any Bidder, upon at least three (3) days request, to present evidence, in form to be specified by the Owner, of such Bidder's experience, qualifications, financial ability, and other matters reasonably related to such Bidder's ability to perform and complete the work covered by such Bidder's proposal. Attached is an AIA 305 Contractor's Qualification Statement, to be completed in its entirety.
- E. The Owner, except to the extent required by Pennsylvania law, shall not be obligated to make an award, if an award is to be made, to the lowest Bidder, or to any other Bidder.

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- F. The work to be done under the Contract for which bids are invited is public work which is subject to various qualifications and restrictions. It is therefore expressly understood and agreed to by each Bidder (Contractor) that, notwithstanding any other provisions of the Contract Documents, the Owner may at any time cancel any award made by it or cancel any contract entered into with the Bidder, without liability to the Bidder, at any time before the Bidder has been directed to begin, and has not actually begun work under the Contract. The Bidder shall have the right similarly to cancel the contract without further obligation, if such Bidder has not received notice to proceed within sixty days following such Bidder's tender of executed Contract Documents in satisfactory form, but only upon such Bidder's giving fifteen days' prior written notice to the Owner, and the Architect, by registered mail, of such Bidder's intentions to exercise such right if notice to proceed is not given by the expiration of the sixty day period.

#### SECTION 7 - CONTRACT BONDS & OTHER PRE-CONTRACT REQUIREMENTS

- A. Before any contract is awarded to the Contractor for the contemplated work, the Bidder, when notified at the address set forth in such proposal, shall furnish and pay for contract bonds, in the forms bound herewith, and in accordance with Sections 756 and 757 of the Public School Code of 1949, as amended, and the Public Works Contractors Bond Law of 1967, of the Commonwealth of Pennsylvania, conditioned as follows:
1. For faithful performance and maintenance of the contract as designated in the **Performance Bond** for a period of two years following final completion of all portions of the work.
  2. For payment of laborers and materialmen as designated in the **Labor and Material Payment Bond**.
- B. The stated principal amounts applicable to the Contract Bond required under Section 7, shall be as follows:
1. For **Labor and Material Payment Bond**, One-Hundred (100%) percent of the amount of the award.
  2. For **Performance Bond**, One-Hundred (100%) percent of the amount of the award.
- C. The Contract Bonds required in Section 7 shall have as surety thereon a corporation duly authorized to conduct business in Pennsylvania which is satisfactory to the Owner. **The bonds shall be provided by a surety with an A.M. Best rating of "A-" (A minus) or better.**
- D. The Contract Bonds required in Section 7, shall be executed by or on behalf of the successful Bidder, as principal, in the following manner:
1. If the successful Bidder is an individual, the Contract Bonds shall be executed by such Bidder, personally; such Bidder's signature shall be witnessed and any trade name employed in the conduct of business shall be stated.
  2. If the successful Bidder is a partnership, the Contract Bonds shall be executed, in the name of the partnership, by each of the partners and the signature of the partners shall be witnessed.
  3. If the successful Bidder is a corporation, the Contract Bonds shall be executed in the name of the corporation: (1) by the president or vice-president and attested by the secretary or assistant secretary, and the corporate seal shall be attached; or (2) by a duly authorized agent of the corporation whose authority to act, as of the date of the Contract Bonds, shall be established by proof satisfactory to the Owner, attached to the Contract Bonds.
- E. The Contract Bonds required in Section 7, shall be executed in behalf of the surety in such manner as shall legally bind the surety. Proper power of attorney evidencing the authority of such agent or agents shall be attached to the Contract Bonds. Such power of attorney shall bear the same date as the Contract Bonds to, which it is attached.
- F. The Contractor shall comply with the Public Works Employment Verification Act and, as a precondition of the Contract, shall submit the Public Works Employment Verification Form to the District along with its bonds, insurance certificates and form of contract. This form is available through the Pennsylvania State website at:

<https://www.pa.gov/content/dam/copapwp-pagov/en/dgs/documents/design-and-construction/public-works-employment-verification/documents/public%20works%20employment%20verification%20form.pdf>

Use the above link for 'Public Works Employment Verification Form'.

## **SECTION 8 - EXECUTION OF CONTRACT & COMMENCEMENT OF WORK**

- A. The successful Bidder to whom an award shall be made by the Owner will be notified in writing of the award, which notice of the award shall be directed to such successful Bidder at the address appearing in such Bidder's proposal. However, in accordance with the Public Works Contractors' Bond Law of 1967, of the Commonwealth of Pennsylvania, the Bidder will be required to furnish the specified Contract Bonds on the forms bound herewith prior to receiving the award. Bonds will become binding upon the award of the Contract.
- B. Within ten (10) days of delivery of the notice of award to any successful Bidder as provided in Section 8, the successful Bidder shall execute and deliver to the Owner the Agreement in the form furnished by the Owner and shall deliver to the Owner proper evidence of the effectiveness of insurance coverage required by the Supplementary General Conditions bound herewith.
- C. Failure of the Bidder to furnish Contract Bonds in accordance with the Contract Documents and to comply with Section 8, or within such extension of time, if any, as provided for by the Owner, in its sole discretion, shall constitute a default by the Bidder under the proposal. The Owner thereafter either may make an award to the next lowest responsible Bidder, to be determined by the Owner in its sole discretion or advertise for new proposals and make an award on the basis thereof. The Owner may charge against such initial Bidder the difference between the amount of the proposal, as accepted by the Owner, and any higher amount for which the required work shall be contracted for by the Owner, together with any additional advertising costs, architect's fees, legal fees, and any and all other fees and expenses incurred by the Owner as a result of such default by the Bidder. These charges shall be irrespective of whether such difference shall exceed the amount of proposal guaranty submitted with the proposal.
- D. The Agreement referred to in Section 8, shall be executed by or on behalf of the successful Bidder in the same manner as is provided in Section 7, with respect to the Contract Bonds.
- E. Commencement of the Work: The successful Bidder, upon notice to proceed by the Owner shall immediately begin to generate shop drawings, submittals and ordering materials due to the nature of the school schedule and the construction schedule.

The intent of the District is to award the contract in July 2025 with an anticipated site mobilization of August 7, 2025.

## **SECTION 9 - NOT USED**

## **SECTION 10 - RESPONSIBILITY OF BIDDER**

- A. Each Bidder before submitting a proposal, shall visit the site of the proposed work and shall be held responsible for having observed and ascertained all visible conditions, which may be encountered in the performance of the work, inter alia, location, general conditions and terrain, accessibility, existing objects and structures, the character and extent of work, if any, then in progress, conditions with respect to adjacent properties and the nature of the neighborhood. Likewise, before submitting a proposal, the Bidder shall become familiar, to the extent possible, with labor conditions, which may affect the performance of the work.

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- B. The submission by any Bidder of a proposal shall constitute conclusive evidence of compliance by such Bidder with Section 10. Any claims at any future time for labor, equipment or materials required, or for difficulties encountered, which could have been foreseen had the Bidder so complied with Section 10, will not be recognized by the Owner.
- C. Each Bidder shall carefully examine all documents and materials bound herewith or related hereto, together with all appropriate bulletins or addends. Such documents shall include, inter alia, the Notice to Bidders, these Instructions to Bidders, the Bid Form (as incorporated on PennBid), the Form of Bid Bond, the Forms of Contract Bonds, the Description of Alternates, the General Conditions, the Supplementary General Conditions, the Drawings, the Technical Specifications, and appropriate Bulletins or Addenda. The submission by any Bidder of a proposal shall constitute conclusive evidence that the Bidder has become satisfied as to the conditions to be encountered, as to the character, quality and quantities of work to be performed and materials to be furnished and as to the requirements of the documents hereinbefore mentioned in this Paragraph C; and no allowance or concession will be made by the Owner, at any time, for lack of such information on the part of the Bidder if that Bidder's proposal subsequently shall be accepted by the Owner.

#### **SECTION 11 - CHANGE PRIOR TO OPENING OF PROPOSALS**

- A. During the period allowed for the preparations of bids, the Architect may furnish to prospective Bidders bulletins or addenda setting forth additions to or alterations of the Contract Documents. The Bidder in the computation of such Bidder's proposal shall include the additions or alterations. The bulletins or addenda shall become a part of the Contract Documents.
- B. It shall be the duty of each prospective Bidder (and any of such Bidder's subcontractors) to ascertain what bulletins and/or addenda, if any, have been promulgated by the Architect which may affect the work to be covered by the proposal of such prospective Bidder and to incorporate that work into the bid.
- C. If any prospective Bidder shall be in doubt as to the true meaning or intent of any part of the Contract Documents, the Bidder may submit a request, in writing, for an interpretation. Any request for such an interpretation shall be delivered to the Architect at least six (6) days prior to the date fixed in the Notice to Bidders bound herewith as the date fixed for receiving, opening, and reading proposals. Any such interpretation will be made only by a bulletin or addenda promulgated by the Architect as provided in Section 11.
- D. The Owner and the Architect shall not be responsible for explanation or interpretations other than contained in bulletins or addenda promulgated as provided in this Section 11. Oral interpretations or explanations shall not be binding upon the Owner or Architect.
- E. Failure of any Bidder to receive any bulletin or addenda as provided for in this Section 11 shall not relieve such Bidder from the obligation of such Bidder's proposal.
- F. Any addenda promulgated by the Architect will be acknowledged, by the Bidder, in the appropriate place on the Bid Form (as incorporated on PennBid)

#### **SECTION 12 - TIME OF COMPLETION: EXTENSIONS OF TIME**

- A. The work to be performed shall be commenced by the Contractor, to the extent possible, as covered in the Contract Documents, within ten (10) days after delivery of a notice to proceed, in writing, by the Owner or the Architect. The nature of the project is such that the time shall be critical. The Prime Contractors and all sub-contractors shall cooperate with each other and shall coordinate their activities and work so that the entire program of construction can be completed on or before **April 9, 2027**.

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### SECTION 13 - DOCUMENTS

- A. Sets of plans, Specifications, and other documents constituting the Contract Documents and requirements for bidding may be obtained at no cost on PennBid.
- B. Any contractor with whom the Owner shall enter into a contract shall be entitled to receive a digital PDF set of plans, Specifications and other documents constituting the Contract Documents related to the work to be performed under such contract, without charge.
- C. All plans, Specifications, and other documents constituting the Contract Documents are the property of the Architect and must be returned.
- D. The Contract Documents furnished to the Bidders are as follows:
  - 1. Specifications: New elementary school; 1200 W. Swedesford road – Specifications
  - 2. Drawings are as follows:  
See Sheet A001 on New elementary school; 1200 W. Swedesford road

### SECTION 14 -INSPECTIONS & TESTING

- A. The Owner will engage testing agencies. Each Prime Contractor is required to coordinate with Inspection agencies.
- B. Refer to General Requirements Section 10 for additional information.

### SECTION 15 - INSURANCE

- A. Reference is made to the Supplementary General Conditions bound herewith for provisions relating to public liability, property damage, workmen's compensation, fire and extended coverage and other insurance which shall be provided and maintained during the period of performance under the Contract. The Contractor shall comply with applicable requirements before commencing any work under the Contract, and, as proof of such compliance, shall deliver to the Owner proper certificates or memoranda.

### SECTION 16 - SUBSTITUTIONS

- A. All proposals must be based upon equipment and materials as specified or drawn, see Section 23 - Standard of Quality, in this Instructions to Bidders.
- B. If a Bidder wishes to substitute an alternative material or product other than that specified or drawn, the Bidder must adhere to the following:
  - 1. Any requested substitution must be submitted to the Architect by the deadline note in Section 1, so the substitution can be reviewed, and the appropriate notification can be made to all other bidders.
  - 2. All proposed substitutions must state the product to be substituted and where in the project it will be furnished. The proposed product literature, drawings, specifications and documents must contain the **comparable information** as was listed in the Specifications and Drawings for the product required by the Contract Documents. This is to enable a direct comparison to the specified product.
  - 3. The Bidder bears the responsibility to furnish the same information as is provided in the Contract Documents. If the information is found to be unclear by the Architect, the Bidder will be required to furnish a sample by the deadline note in Section 1.
  - 4. The Bidder must also provide a list of installations where the proposed product was used, in a similar installation to this project by the deadline note in Section 1.



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- C. It should be understood that the above requirements are to clarify, prior to the time of bidding, whether the proposed alternative is in fact equal to that specified. This process is also intended to allow enough time for the other bidders to be notified of any additionally accepted items. If the above conditions are not met the Bidder will be responsible to furnish the specified items.

#### **SECTION 17 - DETAILED COST BREAKDOWN**

- A. The Contractor, within ten days of the notice of award, shall submit to the Architect for approval a detailed cost breakdown, utilizing AIA Document G703-1992, the total of which shall equal the full amount of the contract (including materials, labor, overhead & profit). Failure of the Contractor to submit an approved, detailed cost breakdown, in the time stated above, will result in withheld payments on requisitions.
1. Such breakdown shall separate, for each product or material, the cost for material from the cost for labor.

#### **SECTION 18 - COMPETENT WORKMEN**

- A. According to Section 752 of the Public School Code of 1949, no person shall be employed to do work under such Contract except competent and first class workmen and mechanics.
1. No workmen shall be regarded as competent first class, within the meaning of this Act, except those who are duly skilled in their respective branches of labor, and who shall be paid not less than such rates of wages and for such hours work as shall be established and current rates of wages paid for such hours by employers of organized labor in doing of similar work in the district where work is being done.

#### **SECTION 19 - PAYMENTS**

- A. Reference is made to the General and Supplementary General Conditions bound herewith for provisions with respect to payments to contractor.
- B. Application for Payment Forms: Contractors must utilize AIA Document G702-1992 and G703-1992 as form for Applications for Payment.
- C. Draft Application for Payment ("Pencil Copy") G702 and G703 to be submitted by the 25<sup>th</sup> day of the month, projecting through the end of the month, for review by the Architect. Upon approval of Draft, Contractors may submit notarized application and additional required documentation.

#### **SECTION 20 - OCCUPATIONAL SAFETY AND HEALTH ACT REQUIREMENTS**

- A. The contractors shall comply with all requirements of the Occupational Safety and Health Act of 1970 (OSHA), along with any amendments thereto.

#### **SECTION 21 - PROVISIONS FOR THE USE OF STEEL AND STEEL PRODUCTS MADE IN THE U.S.A.**

- A. 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 of America as defined therein shall be used or supplied in the performance of the Contract or by any subcontractors thereunder.

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- B. In accordance with Act 161 of 1982, cast iron products shall also be included and produced in the United States of America. Act 141 of 1984, further defines "steel products" to include machinery and equipment. The act also provides clarifications and penalties.
- C. Written and verifiable confirmation of compliance with the requirements of this Section must be furnished to the Architect upon request.

#### **SECTION 22 - 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. Attention is directed to the language of the Commonwealth's non-discrimination clause in 16 PA. Code 49.101.

#### **SECTION 23 - STANDARD OF QUALITY**

- A. The various materials and products specified in this Specifications by name or description are given to establish a standard of quality and of cost for bid purposes. It is not the intent to limit the bidder, the bid, or the evaluation of the bid to any one material or product specified, but rather to name or describe it as the absolute minimum standard that is desired or acceptable. Where proprietary names are used, whether or not followed by the words "or alternatives of the quality necessary to meet the specifications", they shall be subject only as approved by the Architect. A bid containing an alternative which does not meet the specifications may be declared non-responsive. A bid containing an alternative may be accepted but, if an award is made to that bidder, the bidder will be required to replace any alternatives which do not meet the specifications. See Section 16- Substitutions, of these Instructions to Bidders.

#### **SECTION 24 - REQUIREMENTS OF ANTI-POLLUTION LEGISLATION**

- A. On October 26, 1972, House Bill number 1969 was enacted into law. This Act (No. 247) became effective on November 25, 1972. It requires that Bidders on construction contracts for the Commonwealth of Pennsylvania 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 the project on which bids are being received.
- B. The Bidder shall become thoroughly acquainted with the terms of the statutes, rules, and regulations enumerated in this notice, and shall, in such Bidder's bid, price all costs of complying with the terms of the listed statutes, rules, and regulations. No separate or additional payment will be made for such compliance. In the event that the listed statutes, rules, and regulations are amended, or if new statutes, rules, and regulations become effective, after date of receipt of bids, upon the receipt of documentation which causes the Contractor to perform additional work, the Owner may issue a change order request setting forth the additional work that must be undertaken. This change order request shall not invalidate the contract.
- C. It is the responsibility of each contractor to determine what local ordinances, if any, will affect the work. The Contractor shall check for any county, city, borough, or township rules or regulations applicable to the area in which the project is being constructed, and in addition, for any rules or regulations of other organizations having jurisdiction, such as chambers of commerce, planning commissions, industries, or utility companies who have jurisdiction over lands which the Contractor occupies. Any costs of compliance with local controls shall be included in the prices bid, even though documents of such local controlling agencies are not listed herein. Each contractor is hereby directed to comply with all applicable

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Federal, local, and Pennsylvania statutes and regulations administered by the Department of Environmental Resources.

#### **SECTION 25 - PENNSYLVANIA PREVAILING WAGE RATES**

- A. This regulation and the general Pennsylvania prevailing minimum wage rates, (Act 422 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 therefor in the locality in which public work is performed, are made part of this Specification.
- B. Published rates for this Work are bound into this Specification. All questions regarding wage rates, classifications and documentation shall be directed to the Prevailing Wage Division, **717-705-5969**, or **800-932-0665**.

#### **SECTION 26 - ASBESTOS & LEAD**

- A. No A.C.B.M. (asbestos-containing building materials) or A.C.M. (asbestos-containing materials) will be permitted to be used for the construction of this project.
- B. No lead based pipes, solder, or paint shall be used.

#### **SECTION 27 - APPLICATION BACKGROUND CHECKS REQUIRED BY ACT 34.F 1985, ACT 151 1994, ACT 114 2006, AND PDE**

- A. All persons working on a regular basis at the project will be required to submit proof of satisfactory Pennsylvania and FBI criminal background checks required by Section 111 of the Pennsylvania Public School Code. Satisfactory certifications/clearances must be dated no earlier than one year prior to the date presented to the District and **are required before workers are permitted on site**. Costs to obtain these clearances will be paid by the Contractor.
  - 1. Procedures for obtaining the FBI Federal criminal history report can be found at:  
<http://www.identogo.com>  
  
For Act 114, Contractors MUST select the PDE clearance (PA Department of Education). Contractors must submit proof of application within 5 days of Award of Bid.
- B. Satisfactory clearances required by Act 34.F of 1985 Criminal Record Check, and by Act 151 of 1994 Child/Student Abuse Reporting/Clearance, which amended the Department of Welfare's Child Protective Services Law, must be submitted by the Prime Contractor. Contractors must comply with both Act 34.F and Act 151, and supply background checks on all personnel, including sub-contractors and their employees. Satisfactory clearances must be dated no earlier than one year prior to the date presented to the District and **are required before workers are permitted on site**. Costs to obtain these clearances will be paid by the Contractor. Contractors shall note that clearances for Pennsylvania Clearances can take up to 4 weeks to obtain.
  - 1. Procedures for obtaining the Pennsylvania criminal background check (Act 34.F) can be found at:  
<http://epatch.state.pa.us/Home.jsp>
  - 2. Procedures for obtaining the child abuse clearance (Act 151) can be found at:  
<http://www.compass.state.pa.us/CWIS>

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- C. In addition, all persons working on the project will be required to sign form PDE-6004 (9/1/2011), ARREST CONVICTION AND CERTIFICATION FORM (Act 24). The signed form must be sent to the school district with the above three clearances. Furthermore, Form PDE-6004 must be re-submitted to report any new arrest or conviction for any of the prohibited offenses listed on the form within seventy-two (72) hours of an arrest or conviction.
1. Procedures for obtaining the arrest conviction and certification form (Act 24) can be found at:  
<http://www.education.pa.gov/Documents/Teachers-Administrators/Background%20Checks/Arrest%20or%20Conviction%20form.pdf>

## SECTION 28 - LIQUIDATED DAMAGES

- A. Each Contractor shall be liable, and shall pay to the Owner as fixed, agreed, and liquidated damages, the following sums for each calendar day (Sundays and holidays included), which the actual time of Substantial completion shall be delayed beyond the time for Substantial completion set forth in Section 12 of these Instructions to Bidders.

<b>Contract</b>	<b>Damages/Day</b>
General Construction	\$ 5,000.00
Plumbing Construction	\$ 5,000.00
Electrical Construction	\$ 5,000.00
Mechanical Construction	\$ 5,000.00

Site Mobilization: **August 7, 2025**  
Contractor Substantial Completion: **April 9, 2027**

## SECTION 29 - CASH ALLOWANCES

- A. **No** cash allowances for any purposes are included in the Specifications of this project.

## SECTION 30 - PENNSYLVANIA SALES TAX EXEMPTION ARTICLE 22 - STATE SALES TAX

- A. The Owner is exempt (excluded) from sales or use tax in Pennsylvania on certain transactions. The Contractor and all subcontractors shall bid and shall purchase as exempt (excluded) from Pennsylvania sales and use tax all tangible personal property within the definition of "building machinery and equipment" as that term is defined in Act No. 45-1998, Exhibit "A" below and made a part hereof is a true and correct copy of that portion of such Act, which defines the term "building machinery and equipment." In order to facilitate such purchases free of sales and use tax in Pennsylvania, the Owner agrees to execute a certification prepared by the Contractor or a subcontractor as may be required by the regulations of the Pennsylvania Department of Revenue. A sample certificate, "Pennsylvania Exemption Certificate", is included in this Specification.
- B. The Owner may be entitled to claim refunds of sales or use tax paid on other purchases of tangible personal property required in connection with the Work. The Contractor and all subcontractors hereby assign to the 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 to 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 at the Owner's expense to review the books and records of the Contractor and all subcontractors for the purpose of documenting and substantiating any such refund claim. The Contractor and all subcontractors shall cooperate fully with the Owner in pursuing any such refund claim and shall make available to the Owner any applicable documents.

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- C. 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 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 a period of three (3) years, or for such longer periods as may be required by law, after the Final Payment (as defined in the General Conditions, Article 9, "Payments and Completion").
- D. Contractors 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 or use tax which is the subject of the assignment in paragraph B above. The Contractor shall obtain from all subcontractors similar agreements that they will not file claims for refund for any sales or use tax which is the subject of the assignment in Paragraph B above.

**EXHIBIT "A"**

"Building machinery and equipment." Generation equipment, storage equipment, air conditioning equipment, distribution equipment and termination equipment which shall be limited to the following:

- (1) air conditioning limited to heating, cooling, purification, humidification, dehumidification and ventilation;
- (2) electrical;
- (3) plumbing;
- (4) communications limited to voice, video, data, sound, master clock and noise abatement;
- (5) alarms limited to fire, security and detection;
- (6) control system limited to energy management, traffic and parking lot and building access;
- (7) medical system limited to diagnosis and treatment equipment, medical gas, nurse call and doctor paging;
- (8) laboratory system;
- (9) cathodic protection system, or
- (10) furniture, cabinetry and kitchen equipment.

The term shall include boilers, chillers, air cleaners, humidifiers, fans, switchgear, pumps, telephones, speakers, horns, motion detectors, dampers, actuators, grills, registers, traffic signals, sensors, card access devices, guardrails and medical devices, floor troughs and grates, laundry equipment, together with integral coverings and enclosures, whether or not the item constitutes a fixture or is otherwise affixed to the real estate; whether or not damage would be done to the item or its surroundings upon removal; or whether or not the item is physically located within a real estate structure. The term "building machinery and equipment" shall not include guardrail posts, pipes, fittings, pipe supports and hangers, valves, underground tanks, wire conduit, receptacle and junction boxes, insulation, ductwork and coverings thereof.

**SECTION 31 - DISCRIMINATION PROHIBITED**

- A. According to 62 Pa.C.S.A. § 3701, the Contractor agrees that:
1. In the hiring of employees for the performance of work under this Contract, or any subcontract, no contractor, or 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 this Commonwealth who is qualified and available to perform the work to which the employment relates;
  2. No contractor, or subcontractor, or any person on their behalf, shall in any manner discriminate against or intimidate any employee hired for the performance of work under this Contract on account of gender, race, creed, or color;

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3. This Contract may be canceled or terminated by the Owner, and all money due or to become due under this Contract may be forfeited, for a violation of the terms or conditions of that portion of the Contract.

## SECTION 32 - FEDERAL REQUIREMENTS

- A. **EQUAL EMPLOYMENT OPPORTUNITY.** Except as otherwise provided under 41 CFR Part 60, all contracts that meet the definition of “federally assisted construction contract” in 41 CFR Part 60–1.3 must include the equal opportunity clause provided under 41 CFR 60–1.4(b), in accordance with Executive Order 11246, “Equal Employment Opportunity” (30 FR 12319, 12935, 3 CFR Part, 1964–1965 Comp., p. 339), as amended by Executive Order 11375, “Amending Executive Order 11246 Relating to Equal Employment Opportunity,” and implementing regulations at 41 CFR part 60, “Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor.”
- B. **DAVIS-BACON ACT,** as amended (40 U.S.C. 3141–3148). When required by Federal program legislation, all prime construction contracts in excess of \$2,000 awarded by non-Federal entities must include a provision for compliance with the Davis-Bacon Act (40 U.S.C. 3141–3144, and 3146–3148) as supplemented by Department of Labor regulations (29 CFR Part 5, “Labor Standards Provisions Applicable to Contracts Covering Federally Financed and Assisted Construction”). In accordance with the statute, contractors must be required to pay wages to laborers and mechanics at a rate not less than the prevailing wages specified in a wage determination made by the Secretary of Labor. In addition, contractors must be required to pay wages not less than once a week. The non-Federal entity must place a copy of the current prevailing wage determination issued by the Department of Labor in each solicitation. The decision to award a contract or subcontract must be conditioned upon the acceptance of the wage determination. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency. The contracts must also include a provision for compliance with the Copeland “Anti-Kickback” Act (40 U.S.C. 3145), as supplemented by Department of Labor regulations (29 CFR Part 3, “Contractors and Subcontractors on Public Building or Public Work Financed in Whole or in Part by Loans or Grants from the United States”). The Act provides that each contractor or subrecipient must be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he or she is otherwise entitled. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency.
- C. **CONTRACT WORK HOURS AND SAFETY STANDARDS ACT** (40 U.S.C. 3701–3708). Where applicable, all contracts awarded by the non-Federal entity in excess of \$100,000 that involve the employment of mechanics or laborers must include a provision for compliance with 40 U.S.C. 3702 and 3704, as supplemented by Department of Labor regulations (29 CFR Part 5). Under 40 U.S.C. 3702 of the Act, each contractor must be required to compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.C. 3704 are applicable to construction work and provide that no laborer or mechanic must be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.
- D. **RIGHTS TO INVENTIONS MADE UNDER A CONTRACT OR AGREEMENT.** If the Federal award meets the definition of “funding agreement” under 37 CFR § 401.2 (a) and the recipient or subrecipient wishes to enter into a contract with a small business firm or nonprofit organization regarding the substitution of parties, assignment or performance of experimental, developmental, or research work under that “funding agreement,” the recipient or subrecipient must comply with the requirements of 37 CFR Part 401, “Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements,” and any implementing regulations issued by the awarding agency.

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- E. CLEAN AIR ACT (42 U.S.C. 7401–7671q.) and the FEDERAL WATER POLLUTION CONTROL ACT (33 U.S.C. 1251–1387), as amended—Contracts and subgrants of amounts in excess of \$150,000 must contain a provision that requires the non-Federal award to agree to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401–7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251–1387). Violations must be reported to the Federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA).
- F. DEBARMENT AND SUSPENSION (Executive Orders 12549 and 12689)—A contract award (see 2 CFR 180.220) must not be made to parties listed on the government-wide Excluded Parties List System in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 CFR 180 that implement Executive Orders 12549 (3 CFR Part 1986 Comp., p. 189) and 12689 (3 CFR Part 1989 Comp., p. 235), “Debarment and Suspension.” The Excluded Parties List System in SAM contains the names of parties debarred, suspended, or otherwise excluded by agencies, as well as parties declared ineligible under statutory or regulatory authority other than Executive Order 12549.
- G. BYRD ANTI-LOBBYING AMENDMENT (31 U.S.C. 1352)—Contractors that apply or bid for an award of \$100,000 or more must file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. 1352. Each tier must also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier-to-tier up to the non-Federal award.
- H. TERMINATION FOR CAUSE. Tredyffrin/Easttown School District may terminate the whole or any part of this Agreement, by written notice of default to Vendor, in any one of the following circumstances:
1. if Vendor fails to perform any duties or obligations within the time specified herein or any written extension thereof granted by Tredyffrin/Easttown School District;
  2. if Vendor so fails to make progress as to endanger performance of this Agreement in accordance with its terms;
  3. if Vendor fails to comply with any of the material terms and conditions of this Agreement. Such termination shall become effective if Vendor does not cure such failure within a period of ten (10) days after written notice of default by Tredyffrin/Easttown School District;
  4. if the other party is declared insolvent or bankrupt, or makes an assignment for the benefit of creditors, or a receiver is appointed or any proceeding is demanded by, for or against the other under any provision of the Federal Bankruptcy Act or any amendment thereof. Upon termination, Tredyffrin/Easttown School District may procure, upon such terms as it shall deem appropriate, services similar to those so terminated. Vendor shall continue performance of this Agreement to the extent not terminated.
- I. TERMINATION FOR CONVENIENCE. Tredyffrin/Easttown School District may terminate this contract at any time for any reason by giving at least thirty (30) days’ notice in writing to the awarded vendor(s). Such termination shall not be deemed a breach of contract. Tredyffrin/Easttown School District agrees to pay the vendor(s) for all unpaid invoices and uncompensated staff time and expenses up to the date of termination. The vendor must provide a detailed statement of any uncompensated staff time and expenses.

### SECTION 33 - HVAC – COORDINATION WITH CONTROLS SUBCONTRACTOR

- A. The Mechanical Contractor must coordinate with the Mechanical Controls Subcontractor to outfit HVAC equipment with the required onboard control panels. As noted elsewhere, the Mechanical Controls Subcontractor is to be Tri-M Group, LLC, Kennett Square, PA (610-444-1000) [www.tri-mgroup.com](http://www.tri-mgroup.com).

END OF SECTION



COMMONWEALTH OF PENNSYLVANIA  
DEPARTMENT OF REVENUE  
BUREAU OF BUSINESS TRUST FUND TAXES  
DEPT. 280901  
HARRISBURG, PA 17128-0901

## PENNSYLVANIA EXEMPTION CERTIFICATE

### CHECK ONE:

- ☐ STATE OR LOCAL SALES AND USE TAX  
☐ STATE OR LOCAL HOTEL OCCUPANCY TAX  
☐ PUBLIC TRANSPORTATION ASSISTANCE TAXES AND FEES (PTA)  
☐ PASSENGER CAR RENTAL TAX (PCRT)

(Please Print or Type)

This form cannot be used to  
obtain a Sales Tax License  
Number, PTA License Number  
or Exempt Status.

Read Instructions  
On Reverse Carefully

**THIS FORM MAY BE PHOTOCOPIED - VOID UNLESS COMPLETE INFORMATION IS SUPPLIED**

- CHECK ONE:** ☐ PENNSYLVANIA TAX UNIT EXEMPTION CERTIFICATE (USE FOR ONE TRANSACTION)  
☐ PENNSYLVANIA TAX BLANKET EXEMPTION CERTIFICATE (USE FOR MULTIPLE TRANSACTIONS)

Name of Seller or Lessor

Street

City

State

Zip Code

Property and services purchased or leased using this certificate **are exempt** from tax because: (Select the appropriate paragraph from the back of this form, check the corresponding block below and insert information requested.)

- ☐ 1. Property or services will be used directly by purchaser in performing purchaser's operation of: \_\_\_\_\_
- ☐ 2. Purchaser is a/an: \_\_\_\_\_
- ☐ 3. Property will be resold under License Number \_\_\_\_\_ (If purchaser does not have a PA Sales Tax License Number, include a statement under Number 7 explaining why a number is not required.)
- ☐ 4. Purchaser is a/on: \_\_\_\_\_ holding Exemption Number \_\_\_\_\_
- ☐ 5. Property or services will be used directly by purchaser performing a public utility service. (Complete Part 5 on Reverse.)
- ☐ 6. Exempt wrapping supplies, License Number \_\_\_\_\_. (If purchaser does not have a PA Sales Tax License Number, include a statement under Number 7 explaining why a number is not required.)
- ☐ 7. Other \_\_\_\_\_  
(Explain in detail. Additional space on reverse side.)

I am authorized to execute this Certificate and claim this exemption. Misuse of this Certificate by seller, lessor, buyer, lessee, or their representative is punishable by fine and imprisonment.

Name of Purchaser or Lessee

Signature

Date

Street

City

State

Zip Code

### 1. ACCEPTANCE AND VALIDITY:

For this certificate to be valid, the seller/lessor shall exercise good faith in accepting this certificate, which includes: (1) the certificate shall be completed properly; (2) the certificate shall be in the seller/lessor's possession within sixty days from the date of sale/lease; (3) the certificate does not contain information which is knowingly false; and (4) the property or service is consistent with the exemption to which the customer is entitled. For more information, refer to Exemption Certificates, Title 61 PA Code §32.2. An invalid certificate may subject the seller/lessor to the tax.

### 2. REPRODUCTION OF FORM:

This form may be reproduced but shall contain the same information as appears on this form.

### 3. RETENTION

The seller or lessor must retain this certificate for at least four years from the date of the exempt sale to which the certificate applies. **DO NOT RETURN THIS FORM TO THE PA DEPARTMENT OF REVENUE.**

### 4. EXEMPT ORGANIZATIONS:

This form may be used in conjunction with form REV-1715, Exempt Organization Declaration of Sales Tax Exemption, when a purchase of \$200 or more is made by an organization which is registered with the PA Department of Revenue as an exempt organization. These organizations are assigned an exemption number, beginning with the two digits 75 (example: 75-00000-0).



## GENERAL INSTRUCTIONS

Those purchasers set forth below may use this form in connection with the claim for exemption for the following taxes:

- a. State and Local Sales and Use Tax;
- b. PTA rental fee or tax on leases of motor vehicles;
- c. Hotel Occupancy Tax if referenced with the symbol (●);
- d. PTA fee on the purchase of tires if referenced with the symbol (+);
- e. Passenger Car Rental Tax

### EXEMPTION REASONS

- 1.) Property and/or services will be used directly by purchaser in performing purchaser's operation of:

A. Manufacturing      B. Mining      C. Dairying      D. Processing      E. Farming      F. Shipbuilding

This exemption is not valid for property or services which are used in: (a) constructing, repairing, or remodeling of real property, other than real property which is used directly in exempt operations; or (b) maintenance, managerial, administrative, supervisory, sales, delivery, warehousing or other nonoperational activities. Effective October 1, 1991, this exemption does not apply to certain services and PTA tire fee.

- 2.) Purchaser is a/an:

- + A. Instrumentality of the Commonwealth.
- + B. Political subdivision of the Commonwealth.
- + ● C. Municipal Authority created under the "Municipal Authority Acts of 1935 or 1945."
- + ● D. Electric Co-operative Corporation created under the "Electric Co-operative Law of 1990."
- + ● E. Co-operative Agricultural Association required to pay Corporate Net Income Tax under the Act of May 23, 1945, P.L. 893, as amended (exemption not valid for registered vehicles).
- + ● F. Credit Unions organized under "Federal Credit Union Act" or State "Credit Union Act".
- + ● G. Federal Instrumentality
- + ● H. Federal employee on official business (Exemption limited to Hotel Occupancy Tax only. A copy of orders or statement from supervisor must be attached to this certificate.)
- I. School Bus Operator (This Exemption Certificate is limited to the purchase of parts, repairs or maintenance services upon vehicles licensed as school buses by the PA Department of Transportation. For purchase of school buses, see NOTE below.)

- 3.) Property and/or services will be resold or rented in the ordinary course of purchaser's business. If purchaser does not have a PA Sales Tax License Number, complete Number 7 explaining why such number is not required. This Exemption is valid for property or services to be resold: (1) in original form; or (2) as an ingredient or component of other property.

- 4.) Special exemptions

- |                                      |  |
|--------------------------------------|--|
| A. Religious Organization            | E. Direct Pay Permit Holder  |
| B. Volunteer Fireman's Organization  | + ● F. Individual Holding Diplomatic ID  |
| C. Nonprofit Educational Institution | + G. School District   |
| D. Charitable Organization           | H. Tourist Promotion Agency  |
|                                      | (Exemption limited to the purchase of promotional materials for distribution to the public.) |

Exemption limited to purchase of tangible personal property or services for use and not for sale. The exemption shall not be used by a contractor performing services to real property. An exempt organization or institution shall have an exemption number assigned by the PA Department of Revenue and diplomats shall have an identification card assigned by the Federal Government. The exemption for categories "A, B, C and D" are not valid for property used for the following: (1) construction, improvement, repair or maintenance of any real property, except supplies and materials used for routine repair or maintenance of the real property; (2) any unrelated activities or operation of a public trade or business; or (3) equipment used to maintain real property.

- 5.) Property or services will be used directly by purchaser in the production, delivery, or rendition of public utility services as defined by the PA Utility Code.

☐ PA Public Utility Commission and/or

☐ Interstate Commerce Commission

A contract carrier is not entitled to this Exemption and a "Schedule of Charges" filed by such carrier does not satisfy this requirement. This Exemption is not valid for property or services used for the following: (1) construction, improvement, repair or maintenance of real property, other than real property which is used directly in rendering the public utility services; or (2) managerial, administrative, supervisor, sales or other nonoperational activities; or (3) tools and equipment used but not installed in maintenance of facilities or direct use equipment. Tools and equipment used to repair "direct use" property are exempt from tax.

- 6.) Vendor/Seller purchasing wrapping supplies and nonreturnable containers used to wrap property which is sold to others.

- 7.) Other (Attach a separate sheet of paper if more space is required.)

**NOTE:** Do not use this form for claiming an exemption on the registration of a vehicle. To claim an exemption from tax for a motor vehicle, trailer, semi-trailer or tractor with the PA Department of Transportation, Bureau of Motor Vehicles and Licensing, use **FORM MV-1**, "Application for Certificate of Title", for "first time" registrations and **FORM MV-4ST**, "Vehicle Sales and Use Tax Return/Application for Registration", for all other registrations.

## BID BOND

KNOW ALL MEN BY THESE PRESENTS that we, \_\_\_\_\_  
(hereinafter called the "Principal"), and \_\_\_\_\_, a  
corporation authorized to transact business in Pennsylvania, and having its principal office at  
\_\_\_\_\_ (hereinafter called the "Surety"),  
as Surety, are held and firmly bound unto Tredyffrin/Eastown School District (hereinafter called  
the "Obligee"), as Obligee, in the sum of \_\_\_\_\_  
\_\_\_\_\_ Dollars (\$ \_\_\_\_\_) lawful money of the United  
States of America, for payment of which we bind ourselves, and each of our respective heirs,  
legal representatives, successors and assigns, jointly and severally, by these presents on this  
\_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

WHEREAS, said Principal is herewith submitting to the Obligee a bid to perform work for the  
Obligee's proposed \_\_\_\_\_ Project, pursuant to plans,  
specifications, and other Contract Documents incorporated into said bid by reference; and it is  
a condition of the Obligee's receipt and consideration of said bid that such shall be  
accompanied by bid security to be held by the Obligee on terms embodied herein.

THEREFORE, the condition of this obligation is that in the event of acceptance of his bid by  
Obligee and within the period specified therefore in the bidding requirements, said Principal  
shall, within the time set forth in the Bidding Documents, provide to the Obligee (i) the required  
bonds in the required amounts and on the required forms, (ii) certificates of insurance  
evidencing the coverages and minimum limits required by the Contract documents, (iii) a  
properly executed Public Works Employment Verification form, and (iv) signed copies of the  
contract for construction, then this obligation shall be void and of no effect, but otherwise it  
shall remain in full force. In the event of the failure to enter into such contract, give such  
bonds, and furnish such certificates within the time specified, the Principal and Surety will pay  
to the Obligee the amount of this Bid Security together with interest as liquidated damages.

IN WITNESS WHEREOF, the Principal and Surety, intending to be legally bound, have executed  
this Bond the day and year aforementioned.

**(Individual Principal)**

**(SEAL)**

Signature of Individual

Witness:

\_\_\_\_\_  
(Individual Name)

\_\_\_\_\_

(Partnership Principal)

Witness:

\_\_\_\_\_  
(SEAL)

\_\_\_\_\_  
(SEAL)

\_\_\_\_\_  
(SEAL)

(Corporation Principal)

Attest: \_\_\_\_\_  
Secretary/Assistant Secretary

(CORPORATE SEAL)

OR (if applicable)

Attest: \_\_\_\_\_

Trading and doing business as:

\_\_\_\_\_

\_\_\_\_\_  
(Business Name)

\_\_\_\_\_  
(Name of Partnership)

By: \_\_\_\_\_  
Partner

By: \_\_\_\_\_  
Partner

By: \_\_\_\_\_  
Partner

\_\_\_\_\_  
(Name of Corporation)

By: \_\_\_\_\_  
President/Vice President

\*By: \_\_\_\_\_  
Authorized Representative

\*Attach appropriate proof, dated as of the same date as the bond, evidencing authority to execute on behalf of the corporation.

**(CORPORATE SURETY)**

\_\_\_\_\_  
Name of Corporation

Witness or Attest:

\_\_\_\_\_  
By: \_\_\_\_\_

Title

**(CORPORATE SEAL)**

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

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**NON-COLLUSION AFFIDAVIT**

**New elementary school; 1200 W. Swedesford road for the Tredyffrin/Easttown School District**

State of \_\_\_\_\_ :

:

County of \_\_\_\_\_ :

I state that I am \_\_\_\_\_ of \_\_\_\_\_  
(Title) (Name of my firm)

and that I am authorized to make this affidavit on behalf of my firm, and its owners, directors, and officers. I am the person responsible in my firm for the price(s) and the amount of this bid.

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 buyer.
- (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 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,  
(Name of my firm)

subsidiaries, officers, directors and employees are not currently under investigation by any governmental agency and have not in the last four 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 \_\_\_\_\_ understands and acknowledges that  
(Name of my firm)

acknowledges that the above representations are material and important, and will be relied on by

**Tredyffrin/Easttown School District**  
(Name of public entity)

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

**Tredyffrin/Easttown School District**  
(Name of public entity)

of the true facts relating to the submission of bids for this contract.

NON-COLLUSION AFFIDAVIT (Continued)

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\_\_\_\_\_  
Authorized Signature

\_\_\_\_\_  
Printed Name

\_\_\_\_\_  
Company Position

SWORN TO AND SUBSCRIBED

BEFORE ME THIS \_\_\_\_\_ DAY OF \_\_\_\_\_

Notary Public \_\_\_\_\_ My Commission Expires \_\_\_\_\_

INSTRUCTIONS FOR NON-COLLUSION AFFIDAVIT

1. This Non-Collusion Affidavit is material to any contract awarded pursuant to this bid according to the Pennsylvania Antibid-Rigging Act, 73 P.S. SS 1611 et seq., governmental agencies may require Non-Collusion Affidavits to be submitted together with bids.
2. This Non-Collusion Affidavit must be executed by the member, officer, or employee of the bidder who makes final decisions on prices and the amount quoted in the bid.
3. Bid rigging and other efforts to restrain competition and the making of false sworn statements in connection with the submission of bids are unlawful and may be subject to criminal prosecution. The person who signs the Affidavit should examine it carefully before signing and assure himself or herself that each statement is true and accurate, making diligent inquiry, as necessary, of all other persons employed by or associated with the bidder with responsibilities for the preparation, approval or submission of the bid.
4. In the case of a bid submitted by a joint venture, each party to the venture must be identified in the bid documents, and an Affidavit must be submitted separately on behalf of each party.
5. The term "complementary bid" as used in the Affidavit has the meaning commonly associated with that term in the bidding process, and includes the knowing submission of bids higher than the bid of another firm, any intentionally high or noncompetitive bid and other form of bid submitted for the purpose of giving a false appearance of competition.
6. Failure to file an Affidavit in compliance with these instructions will result in disqualification of the bid.



AIA Document A305

# Contractor's Qualification Statement

## 1986 EDITION

*This form is approved and recommended by The American Institute of Architects (AIA) and The Associated General Contractors of America (AGC) for use in evaluating the qualifications of contractors. No endorsement of the submitting party or verification of the information is made by the AIA or AGC.*

The Undersigned certifies under oath that the information provided herein is true and sufficiently complete so as not to be misleading.

SUBMITTED TO:

ADDRESS:

SUBMITTED BY:

NAME:

ADDRESS:

PRINCIPAL OFFICE:

Corporation ☐

Partnership ☐

Individual ☐

Joint Venture ☐

Other ☐

NAME OF PROJECT (if applicable):

TYPE OF WORK (file separate form for each Classification of Work):

\_\_\_\_\_ General Construction

\_\_\_\_\_ HVAC

\_\_\_\_\_ Plumbing

\_\_\_\_\_ Electrical

\_\_\_\_\_ Other \_\_\_\_\_

(please specify)

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## 1. ORGANIZATION

- 1.1 How many years has your organization been in business as a Contractor?
- 1.2 How many years has your organization been in business under its present business name?
  - 1.2.1 Under what other or former names has your organization operated?
- 1.3 If your organization is a corporation, answer the following:
  - 1.3.1 Date of incorporation:
  - 1.3.2 State of incorporation:
  - 1.3.3 President's name:
  - 1.3.4 Vice-president's name(s):
  - 1.3.5 Secretary's name:
  - 1.3.6 Treasurer's name:
- 1.4 If your organization is a partnership, answer the following:
  - 1.4.1 Date of organization:
  - 1.4.2 Type of partnership (if applicable):
  - 1.4.3 Name(s) of general partner(s):
- 1.5 If your organization is individually owned, answer the following:
  - 1.5.1 Date of organization:
  - 1.5.2 Name of owner:



- 1.6 If the form of your organization is other than those listed above, describe it and name the principals:

## **2. LICENSING**

- 2.1 List jurisdictions and trade categories in which your organization is legally qualified to do business, and indicate registration or license numbers, if applicable.
- 2.2 List jurisdictions in which your organization's partnership or trade name is filed.

## **3. EXPERIENCE**

- 3.1 List the categories of work that your organization normally performs with its own forces.
- 3.2 Claims and Suits. (If the answer to any of the questions below is yes, please attach details.)
- 3.2.1 Has your organization ever failed to complete any work awarded to it?
- 3.2.2 Are there any judgments, claims, arbitration proceedings or suits pending or outstanding against your organization or its officers?
- 3.2.3 Has your organization filed any law suits or requested arbitration with regard to construction contracts within the last five years?
- 3.3 Within the last five years, has any officer or principal of your organization ever been an officer or principal of another organization when it failed to complete a construction contract? (If the answer is yes, please attach details.)

- 3.4 On a separate sheet, list major construction projects your organization has in progress, giving the name of project, owner, architect, contract amount, percent complete and scheduled completion date.
  - 3.4.1 State total worth of work in progress and under contract.
  - 3.4.2 For references, provide the names of individuals, along with phone number and e-mail contacts for each such person listed.
- 3.5 On a separate sheet, list the major projects your organization has completed in the past five years, giving the name of project, owner, architect, contract amount, date of completion and percentage of the cost of the work performed with your own forces.
  - 3.5.1 State average annual amount of construction work performed during the past five years.
  - 3.5.2 For references, provide the names of individuals, along with phone number and e-mail contacts for each such person listed.
- 3.6 On a separate sheet, list the construction experience and present commitments of the key individuals of your organization.

#### **4. REFERENCES**

4.1 Trade References:

4.2 Bank References:

4.3 Surety:

4.3.1 Name of bonding company:

4.3.2 Name and address of agent:

## 5. FINANCING

### 5.1 Financial Statement.

#### 5.1.1 Attach a financial statement, preferably audited, including your organization's latest balance sheet and income statement showing the following items:

Current Assets (e.g., cash, joint venture accounts, accounts receivable, notes receivable, accrued income, deposits, materials inventory and prepaid expenses);

Net Fixed Assets;

Other Assets;

Current Liabilities (e.g., accounts payable, notes payable, accrued expenses, provision for income taxes, advances, accrued salaries and accrued payroll taxes);

Other Liabilities (e.g., capital, capital stock, authorized and outstanding shares par values, earned surplus and retained earnings).

#### 5.1.2 Name and address of firm preparing attached financial statement, and date thereof:

#### 5.1.3 Is the attached financial statement for the identical organization named on page one?

#### 5.1.4 If not, explain the relationship and financial responsibility of the organization whose financial statement is provided (e.g., parent-subsidiary).

### 5.2 Will the organization whose financial statement is attached act as guarantor of the contract for construction?

**6. SIGNATURE**

6.1 Dated at this 20 day of

Name of Organization:

By:

Title:

6.2

M being  
duly sworn deposes and says that the information provided herein is true and sufficiently complete so as not to be  
misleading.

Subscribed and sworn before me this 20 day of

Notary Public:

My Commission Expires:

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**PERFORMANCE BOND**

**New elementary school; 1200 W. Swedesford road for the Tredyffrin/Easttown School District**

**Bond No.** \_\_\_\_\_

**BID TITLE:** \_\_\_\_\_

And Now, we \_\_\_\_\_ [CONTRACTOR], as Principal (the  
"Principal"),

and \_\_\_\_\_ [SURETY] , a Corporation organized and  
existing

under the laws of the \_\_\_\_\_ of \_\_\_\_\_ as Surety (the "Surety"), are  
jointly and severally held and firmly bound to the Tredyffrin/Easttown School District, its successors and  
assigns (the "Obligee"), for the performance of the Contract hereinafter identified and incorporated herein  
by this reference

in the sum of \_\_\_\_\_ (Amount of  
Contract), lawful money of the United States of America to be paid to the Obligee; to which performance  
or payment, well and truly to be made, we bind ourselves and each of our successors and assigns, jointly  
and severally.

**I. RECITALS**

WHEREAS, the Principal has submitted to the Obligee a certain proposal, dated \_\_\_\_\_ (the  
"Proposal"),

to perform certain \_\_\_\_\_ General Construction \_\_\_\_\_ Electrical Construction \_\_\_\_\_ Plumbing  
Construction

\_\_\_\_\_ HVAC Construction \_\_\_\_\_ Other: \_\_\_\_\_ (Name of Contract)  
for the

\_\_\_\_\_ (Name of Project) for the  
Obligee, in connection with plans, specifications and other related documents, which are incorporated into  
the Proposal by reference (the "Contract Documents"); and

WHEREAS, the Obligee, is a "contracting body" under provisions of Act No. 385 of the General Assembly  
of the Commonwealth of Pennsylvania, approved by the Governor on December 20, 1967, known as and  
cited as the "Public Works Contractors' Bond Law of 1967" (the "Act");

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WHEREAS, the Act, in Section 3 (a), requires that, before an award shall be made to the Principal by the Obligee in accordance with the Proposal, the Principal shall furnish this Bond to the Obligee, with this Bond to become binding upon the award of a contract to the Principal by the Obligee in accordance with the Proposal; and

WHEREAS, it also is a condition of the Contract Documents that this Bond shall be furnished by the Principal to the Obligee and

WHEREAS, under the Contract Documents, it is provided, inter alia, that if the Principal shall furnish this Bond to the Obligee, and if the Obligee shall make an award to the Principal in accordance with the Proposal, then the Principal and the Obligee shall enter into an agreement with respect to performance of such work (the "Agreement"), the form of which Agreement is set forth in the Contract Documents.

## **II. CONDITIONS OF BOND**

NOW, THEREFORE, the terms and conditions of this Bond are and shall be that if:

(a) the Principal well, truly, and faithfully shall comply with and shall perform the Agreement in accordance with the Contract Documents, at the time and in the manner provided in the Agreement and in the Contract Documents, and if the Principal shall satisfy all claims and demands incurred in or related to the performance of the Agreement by the Principal or growing out of the performance of the Agreement by the Principal, and if the Principal shall indemnify completely and shall hold harmless the Obligee and all of its officers, directors, agents or employees from any and all costs and damages which the Obligee and any or all of its officers, directors, agents and employees may sustain or suffer including, but not limited to, attorney's fees, costs, expenses and interest by reason of the failure of the Principal to do so, and if the Principal shall reimburse completely and pay to the Obligee any and all costs, damages and expenses, including interest and attorney's fees) which the Obligee and any or all of its officers, directors, agents and employees may incur by reason of any such default or failure by the principal and

(b) the Principal shall remedy, without cost to the Obligee, all defects, deficiencies or failures in any labor, materials or equipment performed or provided by the Principal in its performance of the Agreement which may develop during the period of two (2) years from the date of final completion by the Principal and final acceptance of the Obligee of the work to be performed under the Agreement in accordance with the Contract Documents, which defects, in the sole judgment of the Obligee or its legal successors in interests, shall be caused by or shall result from defective or inferior materials or workmanship,

then this Bond shall be void; otherwise, this Bond shall be and shall remain in force and effect.

We further agree to indemnify and hold harmless the Tredyffrin/Easttown School District against any and all costs, liabilities, expenses, attorney's fees and obligations which the School District sustains by reason of the failure of the Principal or the Surety to comply with the terms of the Contract Documents or this Obligation. This Bond is executed and delivered under and subject to the Act, to which reference hereby is made.

The Principal and the Surety agree that any alterations, changes or additions to the Contract Documents, or any alterations, changes or additions to the work to be performed under the Agreement in accordance with the Contract Documents, or any alterations, changes or additions to the Agreement, or any act of forbearance of either the Principal or the Obligee toward the other with respect to the Contract Documents

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and the Agreement, or the reduction of any percentage to be retained by Obligee as permitted by the Contract Documents and by the Agreement, shall not release in any manner whatsoever, the Principal and the Surety or either of them, their heirs, executors, administrators, successors and assigns, from liability and obligations under this Bond; and the Surety, for value received, waives notice of any such alterations, changes, additions, extensions of time, acts of forbearance or reduction of retained percentage.

It is further agreed that, in the sole discretion of the Tredyffrin/Easttown School District and upon notice therefrom, the Surety may be required to perform and carry out the provisions of the Contract in the event of a breach thereof by the Principal, whereupon the rights and responsibilities of the Surety and the Tredyffrin/Easttown School District to each other shall be the same as those of the Principal and the Tredyffrin/Easttown School District immediately prior to the breach giving rise to the Surety's obligation hereunder. If the Surety does not proceed promptly to render such performance or cause such performance to be rendered by a third party satisfactory to the Tredyffrin/Easttown School District, then, the Surety shall be deemed to be in default on this obligation fifteen (15) days after the receipt of notice from Tredyffrin/Easttown School District that the Surety shall so proceed, and the Tredyffrin/Easttown School District shall be entitled to enforce against Surety any remedy it may then or thereafter have against the Principal. If the Principal is a foreign corporation (incorporated under any laws other than those of the Commonwealth of Pennsylvania) then further terms and conditions of this Bond are and shall be that the Principal or the Surety shall not be discharged from liability on this, nor this Bond surrendered until such Principal files with the Obligee a certificate from the Pennsylvania of Revenue evidencing the payment in full of all bonus taxes, penalties and interest, and a certificate from the Bureau of Employment and Unemployment Compensation of the Pennsylvania Department of Labor and industry, evidencing the payment of all unemployment compensation, contributions, penalties and corporations, subcontractors thereunder or for such liability has accrued but the time for payment has not arrived, all in accordance with provisions of the Act of June 10, 1947, P.L. 493, of the Commonwealth of Pennsylvania.

This obligation incorporates by reference the Public Works Contractors' Bond Law of 1967, provided, however, that in the event of any inconsistencies or ambiguity in the meaning of this obligation and the said Public Works Contractors' Bond Law of 1967 the express terms of this obligation shall govern and control.

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IN WITNESS WHEREOF, the Principal and Surety cause this Bond to be signed, sealed and delivered this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

ATTEST:

[NAME OF CORPORATION]

\_\_\_\_\_

By: \_\_\_\_\_  
President

(CORPORATE SEAL)

or, if appropriate

WITNESS

[NAME OF CORPORATION]

\_\_\_\_\_

By: \_\_\_\_\_  
Authorized Representative

(CORPORATE SEAL)

\*Attach appropriate proof, bearing date of Bond,  
evidencing authority to act for Corporation

WITNESS

\_\_\_\_\_  
Corporate Surety

\_\_\_\_\_

By: \_\_\_\_\_  
Attorney-in-Fact

(CORPORATE SEAL)

Issuing Office:

\_\_\_\_\_  
Address

\_\_\_\_\_  
City, State, Zip



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**PAYMENT OR LABOR AND MATERIALMEN'S BOND**

KNOW ALL MEN BY THESE PRESENTS, that we, \_\_\_\_\_

\_\_\_\_\_, as Principal, and

\_\_\_\_\_, as Surety,

are held and firmly bound unto Tredyffrin/Easttown School District as Obligee, in the full and just sum of

\_\_\_\_\_ Dollars (\$\_\_\_\_\_) lawful money of the United States of America,

to be paid to said Obligee, or its assigns, to which payment well and truly to be made and done, we bind ourselves, our heirs, executors, administrators and successors jointly, and severally, firmly by these presents.

Sealed with our respective seals and dated this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_.

WHEREAS, the Principal has submitted to the Obligee a certain proposal, dated \_\_\_\_\_ (the "Proposal"), to perform certain

\_\_\_ General Construction      \_\_\_ Electrical Construction      \_\_\_ Plumbing Construction

\_\_\_ HVAC Construction      \_\_\_ Other \_\_\_\_\_

for the \_\_\_\_\_ (Name of Project) in connection with plans, specifications and other related documents, which are incorporated into the Proposal by reference (the "Contract Documents"); and

WHEREAS, the Obligee, is a "contracting body" under the provisions of Act No. 385 of the General Assembly of the Commonwealth of Pennsylvania, approved by the Governor on December 20, 1967, known as and cited as the "Public Works Contractors' Bond Law of 1967" the "Act");

WHEREAS, the Act, in Section 3 (a), requires that, before an award shall be made to the Principal by the Obligee in accordance with the Proposal, the Principal shall furnish this Bond to the Obligee, with this Bond to become binding upon the award of a contract to the Principal by the Obligee in accordance with the Proposal; and

WHEREAS, the Contract Documents state, inter alia, that if the Principal shall furnish this Bond the Obligee, and if the Obligee shall make an award to the Principal in accordance with the Proposal, then the Principal and the Obligee shall enter into an agreement with respect to performance of such work (the "Agreement"), the form of which Agreement is set forth in the Contract Documents

NOW THEREFORE, the terms and conditions of this Bond are and shall be that if the Principal and any Sub-Contractor of the Principal to whom any portion of the work under the Agreement shall be subcontracted, and if all assignees of the Principal and of any such subcontractor, promptly shall pay or shall cause to be paid, in full, all money which may be due any claimant supplying labor or materials in the prosecution and performance of the work in accordance with the Agreement and in accordance with the Contract Documents, including any amendment, extension or addition to the Agreement and/or to the Contract Documents, for material furnished or labor supplies or labor performed, then this Bond shall be void; otherwise, the Bond shall be and shall remain in force and effect.

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This Bond shall be solely for the protection of claimants supplying labor or materials to the Principal or to any subcontractor of the Principal in the prosecution of the work covered by the Agreement, including any amendment, extension, or addition to the Agreement. The term, "Claimant", when used herein shall mean any individual, firm, partnership, association or corporation. The phrase "Labor or Materials" when used herein shall include public utility services and reasonable rentals of equipment, but only for periods when the equipment rented is actually used at the site of the work covered by the Agreement. The provisions of this Bond shall be applicable whether or not the material furnished or labor performed enters into and becomes a component part of the public building, public work or public improvement contemplated by the Contract Documents and the Agreement.

The Principal and the Surety agree that any claimant, who has performed labor or furnished material in the prosecution of the work in accordance with the Agreement and in accordance with the Contract Documents, including any amendment, extension or addition to the Agreement and/or to the Contract Documents, and who has not been paid therefore, in full, before the expiration of ninety (90) days after the day on which such claimant performed the last of such labor or furnished the last of such materials for which payment is claimed, may institute an action upon this Bond, in the name of the claimant in assumpsit, to recover any amount due the claimant for such labor or material; and may prosecute such action to final judgment and may have execution upon the judgment provided however, that: (a) any claimant who has a direct contractual relationship with any sub-contractor of the Principal but has not contractual relationship, express or implied, with the Principal, may institute an action upon this Bond only if such claimant first shall have given written notice, served in the manner provided in the Act, to the Principal, within ninety (90) days from the date upon which such claimant performed the last of the labor or furnished the last of the materials for which payment is claimed, stating, with substantial accuracy, the amount claimed and the name of the person for whom the work was performed or to whom the material was furnished; and (b) no action upon this Bond shall be commenced after the expiration of one (1) year from the day upon the last of the labor was performed or material was supplied, for the payment of which such action is instituted by the claimant; and (c) every action upon this Bond shall be instituted either in the appropriate court of the County where the Agreement is to be performed or of such other County as Pennsylvania statutes shall provide, or in the United States District Court for the district in which the project, to this Agreement relates, is situated, and not elsewhere.

The Principal and the Surety agree that any alterations, changes and/or additions to the Contract Document, and/or any alterations, changes and/or additions to the work to be performed under the Agreement in accordance with the Contract Documents, and/or any alterations, changes and/or additions to the Agreement, and/or any giving by the Oblige of any extensions of time for the performance of the Agreement in accordance with the Contract Documents, and/or any act of forbearance of either the Principal or the Oblige toward the other with respect to the Contract Documents and the Agreement, and/or the reduction of any percentage to be retained by the Oblige as permitted by the Contract Documents and by the Agreement shall not release in any manner whatsoever, the Principal and the Surety, or either of them, their heirs, executors, administrators, successors and assigns, from liability and obligations under this Bond; and the Surety, for value received, does waive notice of any such alterations, changes, additions, extensions of time, acts of forbearance and/or reduction of retained percentage

It is expressly agreed that this Bond shall be deemed amended automatically and immediately, without formal and separate amendments hereto, upon amendment to the Contract Documents not increasing the contract price more than twenty percent (20%), so as to bind the Principal and the Surety to the full and faithful performance of the Contract Documents as so amended. The term "Amendment," wherever used in this Bond and whether referring to this bond, the Contract Documents, or the Agreement, shall include any alteration, addition, extension or modification of any character whatsoever. Provided, further, that no final settlement between the Oblige and the Principal shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

TREDYFFRIN EASTTOWN SCHOOL DISTRICT  
NEW ELEMENTARY SCHOOL

PAYMENT OR LABOR AND MATERIALMEN'S BOND

#23-037

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IN WITNESS WHEREOF the Principal and Surety, intending to be legally bound, have executed this bond the day and year aforementioned,(Partnerships or Individual Principals sign here)

Signed, sealed and delivered  
in the presence of:

\_\_\_\_\_(Seal)  
(Name of Partnership, Firm or Individual Principal Trading as..., etc.)

\_\_\_\_\_(Seal)

\_\_\_\_\_(Seal)

\_\_\_\_\_(Seal)

\_\_\_\_\_(Seal)

(Corporate Principal sign here)

\_\_\_\_\_  
(Name of Corporation)

ATTEST

By: \_\_\_\_\_  
(President or Vice-President)

\_\_\_\_\_  
(Secretary or Treasurer)

COMPANY

\_\_\_\_\_  
(Witness)

\_\_\_\_\_  
(Attorney-in-fact)

SURETY

PAYMENT OR LABOR AND MATERIALMEN'S BOND

PLMB - 3

## BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project Name:	TESD New Elementary School at 1200 W. Swedesford Road
General Description:	Full renovation of an existing building for a new elementary school with a new construction of a gymnasium and lobby addition.
Project Locality	1200 W. Swedesford Road, Berwy
Awarding Agency:	Tredyffrin Easttown School District
Contract Award Date:	7/15/2025
Serial Number:	25-02863
Project Classification:	Building
Determination Date:	3/17/2025
Assigned Field Office:	Philadelphia
Field Office Phone Number:	(215)560-1858
Toll Free Phone Number:	
Project County:	Chester County

# BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project: 25-02863 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Asbestos & Insulation Workers	6/1/2023		\$57.84	\$43.36	\$101.20
Asbestos & Insulation Workers	5/1/2024		\$59.37	\$46.03	\$105.40
Boilermakers	3/1/2018		\$45.89	\$33.73	\$79.62
Bricklayer	5/1/2023		\$47.50	\$31.42	\$78.92
Carpenter - Chief of Party (Surveying & Layout)	5/1/2023		\$50.57	\$29.02	\$79.59
Carpenter - Chief of Party (Surveying & Layout)	5/1/2024		\$52.58	\$29.02	\$81.60
Carpenter - Chief of Party (Surveying & Layout)	5/1/2025		\$54.59	\$29.02	\$83.61
Carpenter - Instrument Person (Surveying & Layout)	5/1/2023		\$43.97	\$29.02	\$72.99
Carpenter - Instrument Person (Surveying & Layout)	5/1/2024		\$45.72	\$29.02	\$74.74
Carpenter - Instrument Person (Surveying & Layout)	5/1/2025		\$47.47	\$29.02	\$76.49
Carpenter - Rodman (Surveying & Layout)	5/1/2023		\$21.99	\$20.62	\$42.61
Carpenter - Rodman (Surveying & Layout)	5/1/2024		\$22.86	\$20.62	\$43.48
Carpenter - Rodman (Surveying & Layout)	5/1/2025		\$23.74	\$20.62	\$44.36
Carpenters	5/1/2023		\$43.97	\$29.02	\$72.99
Carpenters	5/1/2024		\$45.72	\$29.02	\$74.74
Carpenters	5/1/2025		\$47.47	\$29.02	\$76.49
Cement Finishers & Plasterers	5/1/2022		\$38.57	\$32.39	\$70.96
Cement Masons	5/1/2023		\$44.20	\$32.96	\$77.16
Cement Masons	5/1/2024		\$46.70	\$32.46	\$79.16
Dockbuilder, Pile Drivers	5/1/2023		\$50.48	\$37.99	\$88.47
Dockbuilder, Pile Drivers	5/1/2024		\$52.98	\$37.99	\$90.97
Dockbuilder, Pile Drivers	5/1/2025		\$55.23	\$37.99	\$93.22
Dockbuilder, Pile Drivers	5/1/2026		\$56.98	\$37.99	\$94.97
Dockbuilder/Pile Driver Diver	5/1/2023		\$58.41	\$41.74	\$100.15
Dockbuilder/Pile Driver Diver	5/1/2024		\$61.54	\$41.74	\$103.28
Dockbuilder/Pile Driver Diver	5/1/2025		\$64.35	\$41.74	\$106.09
Dockbuilder/Pile Driver Diver	5/1/2026		\$66.54	\$41.74	\$108.28
Dockbuilder/pile driver tender	5/1/2023		\$50.48	\$37.99	\$88.47
Dockbuilder/pile driver tender	5/1/2024		\$52.98	\$37.99	\$90.97
Dockbuilder/pile driver tender	5/1/2025		\$55.23	\$37.99	\$93.22
Dockbuilder/pile driver tender	5/1/2026		\$56.98	\$37.99	\$94.97
Drywall Finisher	5/1/2023		\$38.77	\$31.12	\$69.89
Drywall Finisher	5/1/2024		\$42.25	\$32.56	\$74.81
Electricians	5/2/2022		\$53.94	\$42.97	\$96.91
Electricians	5/1/2023		\$55.41	\$44.50	\$99.91
Electricians	4/29/2024		\$56.67	\$46.24	\$102.91
Elevator Constructor	1/1/2023		\$66.21	\$43.64	\$109.85
Elevator Constructor	1/1/2024		\$68.97	\$44.70	\$113.67
Elevator Constructor	1/1/2025		\$71.85	\$45.77	\$117.62
Floor Coverer	5/1/2023		\$50.12	\$29.21	\$79.33
Floor Coverer	5/1/2024		\$52.19	\$29.21	\$81.40
Glazier	5/1/2023		\$46.68	\$36.62	\$83.30
Glazier	5/1/2024		\$48.00	\$37.50	\$85.50
Interior Finish	5/1/2023		\$34.60	\$25.80	\$60.40

# BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project: 25-02863 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Iron Workers (Bridge, Structural, Ornamental, Precast)	1/1/2023		\$50.70	\$39.51	\$90.21
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 (Riggers)	7/1/2024		\$44.64	\$34.39	\$79.03
Iron Workers (Rodman/Reinforcing)	7/1/2023		\$45.70	\$34.77	\$80.47
Iron Workers (Rodman/Reinforcing)	7/1/2024		\$47.70	\$34.77	\$82.47
Laborers (Class 01 - See notes)	5/1/2023		\$34.60	\$25.80	\$60.40
Laborers (Class 01 - See notes)	5/1/2024		\$35.85	\$26.00	\$61.85
Laborers (Class 01 - See notes)	5/1/2025		\$37.25	\$26.10	\$63.35
Laborers (Class 02 - See notes)	5/1/2023		\$37.95	\$27.30	\$65.25
Laborers (Class 02 - See notes)	5/1/2024		\$39.40	\$27.55	\$66.95
Laborers (Class 02 - See notes)	5/1/2025		\$41.00	\$27.70	\$68.70
Laborers (Class 03 - See notes)	5/1/2023		\$35.02	\$25.98	\$61.00
Laborers (Class 03 - See notes)	5/1/2024		\$36.27	\$26.18	\$62.45
Laborers (Class 03 - See notes)	5/1/2025		\$37.67	\$26.28	\$63.95
Laborers (Class 04 - See notes)	5/1/2023		\$35.02	\$25.98	\$61.00
Laborers (Class 04 - See notes)	5/1/2024		\$36.27	\$26.18	\$62.45
Laborers (Class 04 - See notes)	5/1/2025		\$37.67	\$26.28	\$63.95
Laborers (Class 05 - See notes)	5/1/2023		\$34.60	\$25.50	\$60.10
Laborers (Class 05 - See notes)	5/1/2024		\$35.85	\$26.00	\$61.85
Laborers (Class 05 - See notes)	5/1/2025		\$37.25	\$26.10	\$63.35
Landscape Laborer	5/1/2023		\$29.45	\$23.98	\$53.43
Landscape Laborer	5/1/2024		\$30.70	\$24.23	\$54.93
Landscape Laborer	5/1/2025		\$32.15	\$24.30	\$56.45
Marble Finisher	5/1/2023		\$39.52	\$29.30	\$68.82
Marble Mason	5/1/2023		\$47.20	\$31.95	\$79.15
Mason Tender, Cement	5/1/2023		\$35.02	\$25.98	\$61.00
Millwright	5/1/2023		\$51.60	\$35.81	\$87.41
Millwright	5/1/2024		\$54.67	\$35.81	\$90.48
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)	5/1/2023		\$52.20	\$32.81	\$85.01
Operators (Building, Class 01 - See Notes)	5/1/2024		\$53.36	\$33.65	\$87.01
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)	5/1/2023		\$55.20	\$33.70	\$88.90
Operators (Building, Class 01A - See Notes)	5/1/2024		\$56.37	\$34.53	\$90.90
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)	5/1/2023		\$51.95	\$32.74	\$84.69
Operators (Building, Class 02 - See Notes)	5/1/2024		\$53.11	\$33.58	\$86.69
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)	5/1/2023		\$54.97	\$33.61	\$88.58

# BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project: 25-02863 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Operators (Building, Class 02A - See Notes)	5/1/2024		\$56.13	\$34.45	\$90.58
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)	5/1/2023		\$47.87	\$31.53	\$79.40
Operators (Building, Class 03 - See Notes)	5/1/2024		\$49.03	\$32.37	\$81.40
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)	5/1/2023		\$47.57	\$31.44	\$79.01
Operators (Building, Class 04 - See Notes)	5/1/2024		\$48.73	\$32.28	\$81.01
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)	5/1/2023		\$45.85	\$30.93	\$76.78
Operators (Building, Class 05 - See Notes)	5/1/2024		\$47.00	\$31.78	\$78.78
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)	5/1/2023		\$44.85	\$30.65	\$75.50
Operators (Building, Class 06 - See Notes)	5/1/2024		\$46.02	\$31.48	\$77.50
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)	5/1/2023		\$63.33	\$37.68	\$101.01
Operators (Building, Class 07A- See Notes)	5/1/2024		\$64.80	\$38.61	\$103.41
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)	5/1/2023		\$63.04	\$37.59	\$100.63
Operators (Building, Class 07B- See Notes)	5/1/2024		\$64.50	\$38.53	\$103.03
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)	5/1/2023		\$42.32	\$32.91	\$75.23
Painters Class 1 (see notes)	5/1/2024		\$42.97	\$34.11	\$77.08
Painters - Line Stripping	12/1/2024		\$44.12	\$27.91	\$72.03
Painters Class 4 (see notes)	5/1/2023		\$44.41	\$32.91	\$77.32
Painters Class 4 (see notes)	5/1/2024		\$45.06	\$34.11	\$79.17
Plasterers	5/1/2023		\$39.32	\$32.64	\$71.96
Plasterers	5/1/2024		\$39.88	\$33.08	\$72.96
plumber	5/1/2023		\$64.73	\$37.61	\$102.34
plumber	5/1/2024		\$67.53	\$38.31	\$105.84
Pointers, Caulkers, Cleaners	5/1/2022		\$47.64	\$30.06	\$77.70
Pointers, Caulkers, Cleaners	5/1/2023		\$48.80	\$30.70	\$79.50
Roofers (Composition)	5/1/2023		\$42.63	\$34.62	\$77.25
Roofers (Composition)	5/1/2024		\$44.13	\$34.77	\$78.90
Roofers (Shingle)	5/1/2023		\$32.85	\$22.10	\$54.95
Roofers (Shingle)	5/1/2024		\$34.35	\$22.20	\$56.55
Roofers (Slate & Tile)	5/1/2023		\$35.85	\$22.10	\$57.95
Roofers (Slate & Tile)	5/1/2024		\$37.35	\$22.20	\$59.55

# BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project: 25-02863 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Sheet Metal Workers	5/1/2023		\$57.31	\$48.97	\$106.28
Sheet Metal Workers	5/1/2024		\$59.22	\$50.56	\$109.78
Sign Makers and Hangars	7/15/2022		\$30.54	\$24.35	\$54.89
Sign Makers and Hangars	7/15/2023		\$31.76	\$24.63	\$56.39
Sign Makers and Hangars	7/15/2024		\$32.32	\$25.82	\$58.14
Sprinklerfitters	1/1/2023		\$62.23	\$31.99	\$94.22
Steamfitters	5/1/2023		\$67.37	\$41.99	\$109.36
Steamfitters	5/1/2024		\$70.32	\$43.09	\$113.41
Stone Masons	5/1/2023		\$47.20	\$31.95	\$79.15
Terrazzo Finisher	5/1/2023		\$43.75	\$27.86	\$71.61
Terrazzo Grinder	5/1/2023		\$44.02	\$27.86	\$71.88
Terrazzo Mechanics	5/1/2023		\$50.26	\$29.56	\$79.82
Tile Finisher	5/1/2023		\$39.52	\$29.30	\$68.82
Tile Setter	5/1/2023		\$50.26	\$29.56	\$79.82
Truckdriver class 1(see notes)	5/1/2023		\$36.29	\$21.55	\$57.84
Truckdriver class 1(see notes)	5/1/2024		\$36.79	\$22.54	\$59.33
Truckdriver class 2 (see notes)	5/1/2023		\$36.39	\$21.55	\$57.94
Truckdriver class 2 (see notes)	5/1/2024		\$36.89	\$22.54	\$59.43
Window Film / Tint Installer	6/1/2019		\$24.52	\$12.08	\$36.60



# BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project: 25-02863 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Carpenter - Chief of Party (Surveying & Layout)	5/1/2023		\$63.24	\$29.06	\$92.30
Carpenter - Chief of Party (Surveying & Layout)	5/1/2024		\$65.19	\$29.06	\$94.25
Carpenter - Chief of Party (Surveying & Layout)	5/1/2025		\$67.15	\$29.06	\$96.21
Carpenter - Chief of Party (Surveying & Layout)	5/1/2026		\$69.10	\$29.06	\$98.16
Carpenter - Instrument Person (Surveying & Layout)	5/1/2023		\$54.99	\$29.06	\$84.05
Carpenter - Instrument Person (Surveying & Layout)	5/1/2024		\$56.69	\$29.06	\$85.75
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)	5/1/2023		\$43.99	\$22.41	\$66.40
Carpenter - Rodman (Surveying & Layout)	5/1/2024		\$45.35	\$22.41	\$67.76
Carpenter - Rodman (Surveying & Layout)	5/1/2025		\$46.71	\$22.41	\$69.12
Carpenter - Rodman (Surveying & Layout)	5/1/2026		\$48.07	\$22.41	\$70.48
Carpenter	5/1/2023		\$54.99	\$29.06	\$84.05
Carpenter	5/1/2024		\$56.69	\$29.06	\$85.75
Carpenter	5/1/2025		\$58.49	\$29.06	\$87.55
Carpenter	5/1/2026		\$60.19	\$29.06	\$89.25
Cement Masons	5/1/2023		\$43.20	\$32.91	\$76.11
Dockbuilder, Pile Drivers	5/1/2023		\$50.48	\$37.99	\$88.47
Dockbuilder, Pile Drivers	5/1/2024		\$52.98	\$37.99	\$90.97
Dockbuilder, Pile Drivers	5/1/2025		\$55.23	\$37.99	\$93.22
Dockbuilder, Pile Drivers	5/1/2026		\$56.98	\$37.99	\$94.97
Dockbuilder/Pile Driver Diver	5/1/2023		\$58.41	\$41.74	\$100.15
Dockbuilder/Pile Driver Diver	5/1/2024		\$61.54	\$41.74	\$103.28
Dockbuilder/Pile Driver Diver	5/1/2025		\$64.35	\$41.74	\$106.09
Dockbuilder/Pile Driver Diver	5/1/2026		\$66.54	\$41.74	\$108.28
Dockbuilder/pile driver tender	5/1/2023		\$50.48	\$37.99	\$88.47
Dockbuilder/pile driver tender	5/1/2024		\$52.98	\$37.99	\$90.97
Dockbuilder/pile driver tender	5/1/2025		\$55.23	\$37.99	\$93.22
Dockbuilder/pile driver tender	5/1/2026		\$56.98	\$37.99	\$94.97
Electric Lineman	5/29/2023		\$60.48	\$32.77	\$93.25
Electric Lineman	6/3/2024		\$62.07	\$33.96	\$96.03
Iron Workers (Bridge, Structural, Ornamental, Precast)	1/1/2023		\$50.70	\$39.51	\$90.21
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)	5/1/2022		\$36.30	\$27.20	\$63.50
Laborers (Class 01 - See notes)	5/1/2023		\$37.55	\$27.45	\$65.00
Laborers (Class 01 - See notes)	5/1/2024		\$38.80	\$27.65	\$66.45
Laborers (Class 01 - See notes)	5/1/2025		\$40.20	\$27.80	\$68.00
Laborers (Class 02 - See notes)	5/1/2022		\$36.50	\$27.20	\$63.70
Laborers (Class 02 - See notes)	5/1/2023		\$37.75	\$27.45	\$65.20
Laborers (Class 02 - See notes)	5/1/2024		\$39.00	\$27.65	\$66.65
Laborers (Class 02 - See notes)	5/1/2025		\$40.40	\$27.80	\$68.20
Laborers (Class 03 - See notes)	5/1/2022		\$36.50	\$27.20	\$63.70

# BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project: 25-02863 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Laborers (Class 03 - See notes)	5/1/2023		\$37.75	\$27.45	\$65.20
Laborers (Class 03 - See notes)	5/1/2024		\$39.00	\$27.65	\$66.65
Laborers (Class 03 - See notes)	5/1/2025		\$40.40	\$27.80	\$68.20
Laborers (Class 04 - See notes)	5/1/2022		\$31.10	\$27.20	\$58.30
Laborers (Class 04 - See notes)	5/1/2023		\$32.35	\$27.45	\$59.80
Laborers (Class 04 - See notes)	5/1/2024		\$33.60	\$27.65	\$61.25
Laborers (Class 04 - See notes)	5/1/2025		\$35.00	\$27.80	\$62.80
Laborers (Class 05 - See notes)	5/1/2022		\$37.15	\$27.20	\$64.35
Laborers (Class 05 - See notes)	5/1/2023		\$38.40	\$27.45	\$65.85
Laborers (Class 05 - See notes)	5/1/2024		\$39.65	\$27.65	\$67.30
Laborers (Class 05 - See notes)	5/1/2025		\$41.05	\$27.80	\$68.85
Laborers (Class 06 - See notes)	5/1/2022		\$37.20	\$27.20	\$64.40
Laborers (Class 06 - See notes)	5/1/2023		\$38.40	\$27.45	\$65.85
Laborers (Class 06 - See notes)	5/1/2024		\$39.70	\$27.65	\$67.35
Laborers (Class 06 - See notes)	5/1/2025		\$41.10	\$27.80	\$68.90
Laborers (Class 07 - See notes)	5/1/2022		\$37.05	\$27.20	\$64.25
Laborers (Class 07 - See notes)	5/1/2023		\$38.30	\$27.45	\$65.75
Laborers (Class 07 - See notes)	5/1/2024		\$39.55	\$27.65	\$67.20
Laborers (Class 07 - See notes)	5/1/2025		\$40.95	\$27.80	\$68.75
Laborers (Class 08 - See notes)	5/1/2022		\$36.80	\$27.20	\$64.00
Laborers (Class 08 - See notes)	5/1/2023		\$38.05	\$27.45	\$65.50
Laborers (Class 08 - See notes)	5/1/2024		\$39.30	\$27.65	\$66.95
Laborers (Class 08 - See notes)	5/1/2025		\$40.70	\$27.80	\$68.50
Laborers (Class 09 - See notes)	5/1/2022		\$36.65	\$27.20	\$63.85
Laborers (Class 09 - See notes)	5/1/2023		\$37.90	\$27.45	\$65.35
Laborers (Class 09 - See notes)	5/1/2024		\$39.15	\$27.65	\$66.80
Laborers (Class 09 - See notes)	5/1/2025		\$40.55	\$27.80	\$68.35
Laborers (Class 10- See notes)	5/1/2022		\$36.80	\$27.20	\$64.00
Laborers (Class 10- See notes)	5/1/2023		\$38.05	\$27.45	\$65.50
Laborers (Class 10- See notes)	5/1/2024		\$39.30	\$27.65	\$66.95
Laborers (Class 10- See notes)	5/1/2025		\$40.70	\$27.80	\$68.50
Laborers (Class 11 -See Notes)	5/1/2022		\$36.70	\$27.20	\$63.90
Laborers (Class 11 -See Notes)	5/1/2023		\$37.95	\$27.45	\$65.40
Laborers (Class 11 -See Notes)	5/1/2024		\$39.20	\$27.65	\$66.85
Laborers (Class 11 -See Notes)	5/1/2025		\$40.60	\$27.80	\$68.40
Laborers (Class 12 -See Notes)	5/1/2022		\$38.40	\$27.20	\$65.60
Laborers (Class 12 -See Notes)	5/1/2023		\$39.65	\$27.45	\$67.10
Laborers (Class 12 -See Notes)	5/1/2024		\$40.90	\$27.65	\$68.55
Laborers (Class 12 -See Notes)	5/1/2025		\$42.30	\$27.80	\$70.10
Laborers (Class 13 -See Notes)	5/1/2022		\$40.43	\$27.20	\$67.63
Laborers (Class 13 -See Notes)	5/1/2023		\$41.65	\$27.45	\$69.10
Laborers (Class 13 -See Notes)	5/1/2024		\$42.93	\$27.65	\$70.58
Laborers (Class 13 -See Notes)	5/1/2025		\$44.33	\$27.80	\$72.13
Laborers (Class 14 -See Notes)	5/1/2022		\$36.55	\$27.20	\$63.75

# BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project: 25-02863 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Laborers (Class 14 -See Notes)	5/1/2023		\$38.25	\$27.45	\$65.70
Laborers (Class 14 -See Notes)	5/1/2024		\$39.50	\$27.65	\$67.15
Laborers (Class 14 -See Notes)	5/1/2025		\$40.90	\$27.80	\$68.70
Laborers Utility (PGW ONLY) (Flagperson)	5/1/2022		\$30.17	\$19.18	\$49.35
Laborers Utility (PGW ONLY) (Flagperson)	5/1/2023		\$31.42	\$19.43	\$50.85
Laborers Utility (PGW ONLY) (Flagperson)	5/1/2024		\$32.67	\$19.63	\$52.30
Laborers Utility (PGW ONLY) (Flagperson)	5/1/2025		\$34.07	\$19.73	\$53.80
Laborers Utility (PGW ONLY)	5/1/2022		\$37.20	\$19.18	\$56.38
Laborers Utility (PGW ONLY)	5/1/2023		\$38.45	\$19.43	\$57.88
Laborers Utility (PGW ONLY)	5/1/2024		\$39.70	\$19.63	\$59.33
Laborers Utility (PGW ONLY)	5/1/2025		\$41.10	\$19.73	\$60.83
Landscape Laborer	5/1/2022		\$27.73	\$23.65	\$51.38
Landscape Laborer	5/1/2023		\$29.03	\$23.80	\$52.83
Landscape Laborer	5/1/2024		\$30.28	\$24.05	\$54.33
Landscape Laborer	5/1/2025		\$31.73	\$24.15	\$55.88
Millwright	5/1/2023		\$51.60	\$35.81	\$87.41
Millwright	5/1/2024		\$54.67	\$35.81	\$90.48
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)	5/1/2023		\$52.20	\$32.81	\$85.01
Operators Class 01 - See Notes (Building, Heavy, Highway)	5/1/2024		\$53.36	\$33.65	\$87.01
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)	5/1/2023		\$55.20	\$33.70	\$88.90
Operators Class 01a - See Notes (Building, Heavy, Highway)	5/1/2024		\$56.37	\$34.53	\$90.90
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)	5/1/2023		\$51.95	\$32.74	\$84.69
Operators Class 02 - See Notes (Building, Heavy, Highway)	5/1/2024		\$53.11	\$33.58	\$86.69
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)	5/1/2023		\$54.97	\$33.61	\$88.58
Operators Class 02a - See Notes (Building, Heavy, Highway)	5/1/2024		\$56.13	\$34.45	\$90.58
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

# BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project: 25-02863 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Highway)					
Operators Class 03 - See Notes (Building, Heavy, Highway)	5/1/2023		\$47.87	\$31.53	\$79.40
Operators Class 03 - See Notes (Building, Heavy, Highway)	5/1/2024		\$49.03	\$32.37	\$81.40
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)	5/1/2023		\$47.57	\$31.44	\$79.01
Operators Class 04 - See Notes (Building, Heavy, Highway)	5/1/2024		\$48.73	\$32.28	\$81.01
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)	5/1/2023		\$45.85	\$30.93	\$76.78
Operators Class 05 - See Notes (Building, Heavy, Highway)	5/1/2024		\$47.00	\$31.78	\$78.78
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)	5/1/2023		\$44.85	\$30.65	\$75.50
Operators Class 06 - See Notes (Building, Heavy, Highway)	5/1/2024		\$46.02	\$31.48	\$77.50
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)	5/1/2023		\$63.33	\$37.68	\$101.01
Operators Class 07 (A) - See Notes (Building, Heavy, Highway)	5/1/2024		\$64.80	\$38.61	\$103.41
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)	5/1/2023		\$63.04	\$37.59	\$100.63
Operators Class 07 (B) - See Notes (Building, Heavy, Highway)	5/1/2024		\$64.50	\$38.53	\$103.03
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, Highway)	5/1/2026		\$67.44	\$40.39	\$107.83
Painters - Line Stripping	12/1/2023		\$42.10	\$27.43	\$69.53
Painters - Line Stripping	12/1/2024		\$44.12	\$27.91	\$72.03
Painters Class 2 (see notes)	2/1/2023		\$48.82	\$32.09	\$80.91
Painters Class 2 (see notes)	2/1/2024		\$49.57	\$33.34	\$82.91

# BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project: 25-02863 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Painters Class 2 (see notes)	2/1/2025		\$50.85	\$33.91	\$84.76
Painters Class 3 (see notes)	2/1/2023		\$59.78	\$32.13	\$91.91
Painters Class 3 (see notes)	2/1/2024		\$60.53	\$33.38	\$93.91
Painters Class 3 (see notes)	2/1/2025		\$61.81	\$33.95	\$95.76
Steamfitters (Heavy and Highway - Gas Distribution)	5/1/2023		\$64.00	\$41.68	\$105.68
Steamfitters (Heavy and Highway - Gas Distribution)	5/1/2024		\$66.80	\$42.93	\$109.73
Steamfitters	5/1/2018		\$56.37	\$34.39	\$90.76
Truckdriver class 1(see notes)	5/1/2023		\$36.14	\$21.55	\$57.69
Truckdriver class 1(see notes)	5/1/2024		\$36.64	\$22.54	\$59.18
Truckdriver class 2 (see notes)	5/1/2023		\$36.24	\$21.55	\$57.79
Truckdriver class 2 (see notes)	5/1/2024		\$36.74	\$22.54	\$59.28

**NEW ELEMENTARY SCHOOL; 1200 W. SWEDESFORD RD.**

**TREDYFFRIN / EASTTOWN SCHOOL DISTRICT  
SUPPLEMENTARY GENERAL CONDITIONS  
FOR THE CONTRACT FOR CONSTRUCTION**

THE AMERICAN INSTITUTE OF ARCHITECTS Standard Form A-201, 1987 Edition, of the General Conditions of the Contract for Construction, Articles 1 through 14, pages 1 through 24 inclusive, are included as part of the specifications and will be binding upon all contractors, subcontractors and sub-subcontractors. However, said General Conditions are amended or modified as set forth in these Supplementary General Conditions. Where any section of the standard form is not specifically amended, deleted or supplemented hereby, it shall remain in effect as originally written. In the case of any conflict between the provisions of these Supplementary General Conditions and the General Conditions, the provisions of these Supplementary Conditions shall prevail.

**ARTICLE 1 - GENERAL CONDITIONS**

**Section 1.1.1** is amended by deletion of the first sentence thereof and by substitution of the following therefor:

The Contract Documents consist of the Agreement between Owner and Contractor (hereinafter the "Agreement"), Conditions of the Contract (General, Supplementary and other Conditions), Drawings, all Specifications including the General Requirements, Notice to Bidders, Instructions to Bidders, Bond forms, other documents listed in the Agreement and Modifications issued after execution of the Contract.

**Section 1.1.2** is amended by deletion of the last sentence thereof and by substitution of the following therefor:

The Architect shall, however, be entitled to performance and enforcement of those obligations of the Contractor under the Contract intended to facilitate performance of the Architect's duties.

**Section 1.2.1** is deleted in its entirety and the following is substituted therefore:

The Contract Documents shall be signed in not less than triplicate by the Owner and Contractor. If the Owner and/or the Contractor do not sign the Conditions of the Contract, Drawings, Specifications or any other Contract Document, the Architect shall identify such document for the Owner.

**Section 1.2.6** is added as follows:

The Specifications determine the standards of quality and the types and methods of workmanship; the Drawings establish the quantities, dimensions and details, the Drawings and Schedule give the location of materials.

Any discrepancies among, or omission in, the Contract Documents shall be called to the Architect's attention by the Contractor before proceeding with the Work affected thereby. In case of discrepancy among the Contract Documents regarding quantity or quality or both, the better quality and the greater quantity (as determined by the Architect) shall be included in the bid and the Contract and, unless otherwise directed in writing by the Architect, shall be performed or furnished.

Any conflict in the Drawings or Specifications as to which of the separate contractors is to perform specific Work, shall be resolved by the Architect, whose decision shall be final and binding.

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## ARTICLE 2 - OWNER

Sections 2.1.2 and 2.2.1 are deleted in their entireties.

Section 2.2.3 is deleted in its entirety and the following is substituted therefor:

The Owner shall secure and pay for any and all necessary land development approvals, zoning approvals, easements and assessments required for construction.

Section 2.2.5 is deleted in its entirety and the following is substituted therefor:

General Contractors will be furnished with four copies of Drawings and Project Manuals, free of charge.

Section 2.4.1 is deleted in its entirety and the following is substituted therefor:

If the Contractor fails within seven (7) days after written notice from Owner to correct defective or non-conforming Work or to remove and replace rejected Work as required by the Architect or Owner, or if the Contractor fails to perform Work in accordance with the Contract Documents (including any requirements of the Progress Schedule), the Owner may correct, remedy or complete such deficiency.

To the extent necessary to complete corrective and remedial action, the Owner may exclude the Contractor from all or part of the Work, and suspend the Contractor's services related thereto, take possession of the Contractor's tools, appliances, construction equipment and machinery at the site and incorporate in the Work all materials and machinery and equipment stored at the site as may be necessary to enable the Owner to exercise its rights under this Section. All direct and indirect costs of the Owner exercising such rights shall be charged against the Contractor in an amount verified by the Architect and a Change Order shall be issued incorporating (a) the necessary revisions in the Contract Documents and (b) a reduction in the Contract sum. Such direct and indirect costs shall include, in particular, but without limitation, compensation for additional services required and all costs of repair and replacement of Work of others destroyed or damaged by correction, removal or replacement of the Contractor's defective Work. The Contractor shall not be allowed any extension of the Contract Time because of any delay in performance of the Work attributable to exercise by the Owner of its rights hereunder.

## ARTICLE 3 - CONTRACTOR

Section 3.1.1 is amended by addition of the following at the end thereof:

The term "Contractor" shall include the General Contractor, Mechanical Contractor, Plumbing Contractor and Electrical Contractor entering into a contract with the Owner.

Section 3.3.5 is added as follows:

The Contractor covenants with the Owner to furnish its best skill and judgment and to cooperate with the Architect and Owner in furthering the interests of the Owner. The Contractor agrees to furnish efficient business administration and Superintendents and to use its best effort to furnish at all times an adequate supply of workers and materials and to perform the Work in the most efficient and expeditious manner consistent with the interests of the Owner.

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**Section 3.5.1** is deleted in its entirety and the following is substituted therefor:

The Contractor warrants to the Owner and Architect that materials and equipment furnished under this Contract will be new unless otherwise specified, and all Work will be of good quality, free from faults and defects and in conformance with the Contract Documents. Contractor further warrants that the Work will be free from defects not inherent in the quality required or permitted, and that the Work will conform to the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, shall be considered defective. If requested by the Owner or Architect, the Contractor shall furnish satisfactory evidence as to the kind and/or quality of materials and equipment. The Contractor shall collect and deliver to the Architect or Owner all written warranties given to Owner by others for the Project Work.

**Section 3.6.1** is deleted in its entirety and the following is substituted therefor:

The Contractor and all subcontractors and sub-subcontractors must comply with all laws governing the payment of sales tax, consumer, use and similar taxes related to the Work.

The Contractor shall check all materials, equipment and labor entering into the Work. In form and system satisfactory to the Owner, the Contractor shall keep such full and details accounts as may be necessary for proper financial management under this Contract. 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. The Contractor shall preserve all such records for a period of three (3) years or for such longer period as may be required by law, after final payment.

The Contractor agrees to assign and transfer to the Owner all of its rights to sales and use tax which may be refunded as a result of a claim for a refund for materials purchased in connection with this Contract. The Contractor further agrees that it will not file a claim for refund of any sales or use tax which is the subject of this assignment.

The Contractor agrees to include the provisions of this Section 3.6.1, in full, in any contracts with subcontractors and to require that subcontractors include same in contracts with sub-subcontractors.

**Section 3.7.1** is deleted in its entirety and the following is substituted therefor:

Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for building permits and for all other permits and governmental fees, licenses and inspections necessary for the proper execution and completion of the Work. It shall be the Owner's responsibility to reimburse the Contractor for a local "building" permit, which will be obtained from and required by Tredyffrin Township. In addition, the Contractor shall pay for and secure necessary Use and Occupancy permits prior to requesting issuance of a Certificate of Substantial Completion. Further, the Contractor shall pay all charges of utility service companies for connection to the Work. The Owner shall pay charges of companies for capital costs related to such utilities, including, for example, a sewer tapping fee.

**Section 3.7.3** is deleted in its entirety and the following is substituted therefor:

If the Contractor observes that portions of the Contract Documents or the Work are at variance with current laws, ordinances, rules, regulations, permits or other lawful orders of public authorities, the Contractor shall promptly notify the Architect and Owner in writing so that necessary changes may be accomplished by appropriate modification.



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**Section 3.7.5** is added as follows:

The Contractor shall comply with all applicable federal and state laws, local ordinances, statutes, building codes, highway regulations, and with all regulations and requirements of the Department of Education, Bureau of Labor and Industry and Department of Transportation of the Commonwealth of Pennsylvania. As set forth in Article 13, the Contractor shall comply with all provisions of the Prevailing Wage Act. A schedule of prevailing wage rates is included with the specifications.

**Section 3.8**, including subsections 3.8.1 and 3.8.2, is deleted in its entirety.

**Section 3.9.2** is added as follows:

Prior to execution of the Contractor-Owner Agreement, the Contractor shall submit to the Architect, and the Owner an updated résumé and other supporting documentation of experience and competency for the proposed superintendent on the Project. Should the Owner or the Architect find the proposed superintendent unacceptable for any reason, the Contractor shall submit additional names and résumés for consideration by the Owner and Architect. Once hired, the Contractor shall not replace its superintendent without prior notice to the Owner. The requirements contained in this Section shall apply to any proposed replacement superintendent regardless of whether the proposed tenure of the superintendent is temporary or permanent.

**Section 3.13.1** is deleted in its entirety and the following is substituted therefor:

The Contractor shall confine operations at the site to times and areas permitted by the Owner, law, ordinances, permits and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

**Section 3.15.3** is added as follows:

As the buildings and site will be occupied during a part of the construction, the Contractor will be responsible on an ongoing basis to keep construction dirt from finding its way into or infiltrating any occupied areas. This responsibility shall apply to inside areas, outside paving and play areas and lawns. The Contractor shall also be responsible for cleaning construction dirt and mud from internal roadways, parking lots and adjacent roads. At the end of each work day during the course of construction, the Contractor shall clean and remove all dirt, dust and debris from the site. Dust shall be kept to a minimum at all times. It is the responsibility of the contractor to provide any equipment necessary for dust control. In addition to removal of dirt, dust and debris on a daily basis, at the completion of the Project and prior to request for final payment, the following additional clean up shall be completed:

- A. Removal of all stains, marks, fingerprints, mortar or paint spots and other defacements from all finished Work both exterior and interior including, but not limited to, finishing hardware, tilework, cabinet work, glass, etc.;
- B. clean all fixtures and equipment.
- C. and vacuum and/or wash all finish floors.

**Section 3.18.1** is deleted in its entirety and the following is substituted therefor:

The Contractor agrees to protect, defend, indemnify and hold the Owner (Tredyffrin/Easttown School District) and its agents and agencies, the Architect, the Engineer, and any other party specifically named by the Owner, free and harmless from and against any and all losses, penalties, damages, settlements, costs, charges, professional fees or other expenses or liabilities of every kind and character arising out of or

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relating to any and all claims, liens, demands, obligations, actions, proceedings, or causes action of every kind and character in connection with or arising directly or indirectly out of the Contract and/or the performance thereof. Without limiting the generality of the foregoing, any and all such claims, etc., relating to personal injury, death, damage to property, defects in materials or workmanship, actual or alleged infringement of any patent, trademark, copyright (or application for any other tangible or intangible personal or property right), or any actual or alleged violation of any applicable statute, ordinance, administrative order, rule or regulation, or degree of any court, shall be included in the indemnity hereunder. The Contractor further agrees to investigate, handle, respond to, provide defense for and defend any such claims, etc., at its sole expense and agrees to bear all other costs and expenses related thereto, even if it (claims, etc.), is groundless, false or fraudulent. This indemnification shall apply to the acts or omissions of the Contractor, any subcontractor, or any one directly or indirectly employed by any of them or any one for whose acts any of them may be liable, regardless of whether or not caused in part by a party indemnified hereunder. In the event such indemnification violates any law, the foregoing provisions shall not be construed to indemnify the Owner and its agents and agencies and the Architect and the Engineer for liability arising out of bodily injury to persons or damage to property caused by or resulting from the sole negligence of those parties.

#### **ARTICLE 4 - ADMINISTRATION OF THE CONTRACT**

**Section 4.1.3** is deleted in its entirety and the following is substituted therefor:

In case of termination of employment of the Architect, the Owner shall appoint an Architect whose status under the Contract Documents shall be that of the former Architect.

**Section 4.1.4** is deleted in its entirety.

**Section 4.2.5** is amended by addition of the following at the end thereof:

Except for requests for payment for changes in the Work which require approval of Board of School Directors, the Architect shall have seven (7) days to review Contractor's payment requests and payment shall be made thirty-two (32) days from the Architect's receipt of the request where the Owner and Architect approve of same. No request for payment will be approved unless accompanied by verified statements certifying payment of prevailing wages under the Prevailing Wage Act for all Work for which payment request is made.

**Section 4.2.6** is amended by addition of the following at the end thereof:

In addition to the Architect, the Owner will have authority to reject work which does not conform to the Contract Documents. The Architect and the Owner shall at all times have access to the Work wherever it is preparation and/or progress. The Contractor shall provide facilities for such access.

**Section 4.2.11** is deleted in its entirety and the following is substituted therefor:

The Architect will interpret matters concerning performance and requirements of the Contract Documents upon written request of either the Owner or the Contractor. Architect's response to such requests will be made with reasonable promptness as agreed upon but in no event later than fifteen (15) days after the Architect's receipt of the written request. The Owner shall decide matters concerning performance under and requirements of the Contract Documents. The decisions of the Owner shall be consistent with the intent of or reasonably inferable from the Contract Documents and decisions will be issued in writing or in the form of drawings.

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**Section 4.5**, including subsections 4.5.1, 4.5.2, 4.5.3, 4.5.4, 4.5.4.1, 4.5.4.2, 4.5.5, 4.5.6 and 4.5.7, is deleted in its entirety. A new **Section 4.5** is added as follows:

Any controversy or claim arising out of or related to the Contract or breach thereof that is not resolved pursuant to the provisions of Section 4.4 may be brought in a civil action by the Owner or Contractor in the Court of Common Pleas of Chester County. The Owner may at its sole discretion elect to submit its claim to non-binding mediation and/or binding arbitration. However, prior to the Contractor commencing an action in the Court of Common Pleas of Chester County, the Contractor is required to submit written notice to the Owner of its intent to commence an action upon the Owner, and the Owner, at its sole discretion, may demand that the matter be submitted to mediation and/or arbitration. If the Owner elects that any claim be submitted to arbitration, the arbitration shall be in accordance with the construction industry arbitration rules of the American Arbitration Association. During the Court of Common Pleas proceedings, mediation proceedings and/or arbitration proceedings, the Owner and Contractor shall comply with sub paragraph 4.3.4.

#### **ARTICLE 5 - SUBCONTRACTORS**

**Section 5.3.2** is added as follows:

The Owner shall have the right, but not the obligation, to pay subcontractors directly if the Architect advises the Owner that, in his opinion, failure of the Contractor to pay the subcontractor in question would be detrimental to the progress of the Work. In such cases, the Owner may withhold from the prime Contractor, money believed to be due the subcontractor and to pay the subcontractor directly. The Owner or the Architect may furnish to any subcontractor or sub-subcontractor or any other person or organization, evidence of amounts paid to the Contractor on account of the specific Work done by the subcontractor or sub-subcontractor.

#### **ARTICLE 6 - WORK BY OWNER OR BY SEPARATE CONTRACTORS**

**Section 6.1.1** is deleted in its entirety and the following is substituted therefor:

The Owner reserves the right to perform work related to the Project with its own forces, and to award separate contracts in connection with other portions of the Project or other work on the site under these or similar conditions of the Contract. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, he shall make such claim as provided elsewhere in the Contract Documents.

**Section 6.1.3** is deleted in its entirety and the following is substituted therefor:

The Contractor shall be responsible for coordinating all work activities on the project and prepare construction schedules, including revisions thereto, when appropriate, for the efficient coordination of the work. The resulting construction schedules shall be used by the Contractor and the Owner until subsequently revised.

**Section 6.1.4** is deleted in its entirety.

**Section 6.2.4** is amended by addition of the following at the end thereof:

Any losses, damages, costs, charges or expenses caused by defective or ill-timed Work shall be borne by the Contractor, who shall be responsible to the Owner therefor.

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**Section 6.2.7** is added as follows:

Should the Contractor cause damage to the Work or property of any subcontractor or should any claim arising out of the Contractor's performance of Work at the site be made by any separate contractor against the Contractor, the Owner or any other person, the Contractor shall promptly attempt to settle with such other contractor by agreement, or to otherwise resolve the dispute. The Contractor shall, to the fullest extent permitted by law, indemnify and hold the Owner and the Architect harmless from and against all claims, damages, losses and expenses, including but not limited to attorneys' fees, court and arbitration costs, arising out of any action, legal or equitable, brought by any separate contractor on a claim arising out of the Contractor's Work at the site. Should a separate contractor cause damage to Work or property of the Contractor, or should the Work of any separate contractor at the site give rise to any other claim, the Contractor covenants and agrees that it will not institute any action against the Owner or the Architect to be maintained and continued in its name or for its benefit in any court or before any arbiter which seeks to impose liability on or to recover damages from the Owner or the Architect on account of any such damage or claim. If the Contractor is delayed at any time with the progress of the Work by any act or neglect of a separate contractor, the Contractor shall make a request to the Architect and Owner for an extension of time within fifteen (15) days of occurrence of the act or neglect of such separate contractor giving rise to the delay. Notwithstanding anything in the General Conditions to the contrary, no extension of time shall be granted if the Contractor fails to notify the owner and the Architect of any such delay within the said fifteen (15) day period. An extension of the Contract time shall be the Contractor's exclusive remedy with respect to the Owner for any delay caused by a separate contractor.

## **ARTICLE 7 - CHANGES IN THE WORK**

**Section 7.1.2.1 and 7.1.2.2** are added as follows:

**7.1.2.1** The process for a Change Order shall be as follows:

- .1 If the Contractor believes a Change Order may be necessary the issue should first be discussed with the Architect or respective Engineer.
- .2 If it is deemed necessary then a complete and clear written description of the work, along with detailed cost breakdown, shall be submitted to the Architect for review.
- .3 Following review, and approval by the Owner, the Contractor will be directed to start work. No work should take place without the Owner's approval.

**7.1.2.2** When no unit prices are included and when the actual cost of the Work forms the basis for the amount to be paid to the Contractor, the Contractor shall add overhead and profit according to the following:

- .1 No more than fifteen percent (15%) shall be added to the cost of the Work if it is work done by the Contractor. Supervision, labor, material and equipment define the cost of the Work. Said fifteen percent (15%) shall be all-inclusive and no additional charges for items such as insurance or bonds will be approved.
- .2 No more than Eight percent (8%) shall be added to the cost of the Work done by subcontractors or sublet. Said eight percent (8%) shall be all-inclusive and no additional charges for items such as insurance or bonds will be approved.
- .3 A subcontractor may add no more than ten percent (10%) to the cost of the work. Supervision, labor, material and equipment define the cost of the Work. Said ten percent (10%) shall be all-inclusive and no additional charges will be approved.

**Section 7.3.3.2** is deleted in its entirety and the following is substituted therefor:

Unit prices are set forth in the Contract Documents or subsequently agreed upon. Fifteen percent (15%) to cover overhead, coordination and profit shall be added to changes which increase the scope of the work.

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Costs associated with overhead, coordination and profit will not be included on changes which decrease the scope of the work. Under no conditions shall additional charges such as insurance or bond be approved.

**Section 7.3.3.3** is deleted in its entirety and the following is substituted therefor:

When no unit prices are included and when the actual cost of the Work forms the basis for the amount to be paid to the Contractor, the Contractor shall add overhead and profit according to the following:

- (a) No more than fifteen percent (15%) shall be added to the cost of the Work if it is work done by the Contractor. Supervision, labor, material and equipment define the cost of the Work. Said fifteen percent (15%) shall be all-inclusive and no additional charges for items such as insurance or bonds will be approved.
- (b) No more than Eight percent (8%) shall be added to the cost of the Work done by subcontractors or sublet. Said eight percent (8%) shall be all-inclusive and no additional charges for items such as insurance or bonds will be approved.
- (c) A subcontractor may add no more than ten percent (10%) to the cost of the work. Supervision, labor, material and equipment define the cost of the Work. Said ten percent (10%) shall be all-inclusive and no additional charges will be approved.

**Section 7.3.7** is amended by deletion of the last sentence thereof and substitution of the following therefor:

Any change in the Contract Sum resulting from such claim shall be authorized by Change Order and calculated as set forth in Section 7.3.3.

**Section 7.5.1** is added as follows:

If notice to any surety of any change effecting the general scope of the Work or change in the Contract Sum is required by the provisions of any bonds, it will be the Contractor's responsibility to so notify the surety, and the amount of each applicable fund shall be adjusted accordingly. The Contractor shall furnish proof of such adjustment to the Owner.

## ARTICLE 8 - TIME

**Section 8.3.1** is deleted in its entirety and the following is substituted therefor:

Except as otherwise provided in Section 8.3.3, if the Contractor is delayed in progress of the Work by an act or neglect of the Owner, the Architect or any other contractor, or by causes beyond Contractor's control and without Contractor's fault or negligence, or by cessation of Work which shall be authorized by the Owner or the Architect or by any other cause which the Owner shall determine to be proper, then the time of completion determined as provided may be extended by the Owner for such reasonable time as the Owner, with advice from the Architect, shall determine to be equitable and just.

**Section 8.3.3** is deleted in its entirety and the following is substituted therefor:

No extension of time shall be granted because of seasonal or abnormal variations in temperature, humidity or precipitation, which conditions shall be wholly at the risk of the Contractor, whether occurring within the time originally scheduled for completion, or within the period within any extension granted. Any additional cost of operations or conditions shall be the responsibility of the Contractor. The Contractor hereby agrees that it shall have no claim for damages of any kind on account of any delay in the commencement of the Work, and/or any delay or suspension of any portion of the Work, whether such

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delay is caused by the Owner, the Architect or otherwise. The Contractor acknowledges that its sole remedy for any such delay and/or suspension will be an extension of time as provided herein.

**Section 8.3.4** is added as follows:

No extension of time for completion shall be granted unless a claim or request therefor shall be made, in writing, to the Owner or the Architect by the Contractor within seven (7) days of the occurrence or act which the Contractor believes entitles it to an extension of time of completion; provided, however, if the occurrence or act shall constitute a continuing case of delay, only one claim or request by the Contractor shall be necessary. Failure of the Contractor to make a claim or request for an extension within the seven (7) day period shall constitute a waiver and relinquishment of the right of the Contractor to make a claim or request for an extension of time of completion based upon such act or occurrence, at any time in the future.

**Section 8.3.5** is added as follows:

No extension of time of completion will be granted by the Owner if the act or occurrence constituting the basis of the request or claim therefor by the Contractor shall be the non-delivery of materials due to any act or neglect of the Contractor, or the breakdown of equipment in use or intended to be used by the Contractor, or the failure of the Contractor to order, employ, furnish or obtain as necessary for the timely prosecution of the Work, sufficient labor, material, equipment or other matters which shall be within the control of the Contractor. The Contractor shall be solely responsible to the Owner for delays resulted from the causes set forth herein or for the Contractor's failure to make timely claim as set forth in Section 8.3.4.

**Section 8.3.6** is added as follows:

No extension of time of completion which shall be granted by the Owner shall be or shall be deemed to be a waiver by the Owner of any rights accruing to it under the Contract Documents and no extension of the time of completion which shall be granted by the Owner shall relieve the Contractor from full responsibility for the performance of its obligations under the Contract.

**Section 8.3.7** is added as follows:

The Owner shall not be liable to the Contractor for any expenses, damages, loss of profits (anticipated or otherwise) or charges of any nature whatsoever which shall result from the Owner's granting of an extension of the time of completion to any contractor or which shall result because of any delay or hindrance of any nature whatsoever in the progress of the Work, whether such delay or hindrance shall be avoidable or unavoidable. If the Owner actively interferes with the Contractor's progress of the Work, then the Owner may be responsible for costs actually, necessarily, and reasonably incurred by the Contractor as the direct result of the Owner's active interference if (1) the Contractor provided prompt written notice of the active interference, (2) the costs claimed are not otherwise disclaimed in the Contract Documents, and (3) neither the Contractor, nor any third party was also for the delay or a concurrent delay. The time of completion (which shall give effect to any extensions of time of completion which shall be granted by the Owner) shall be of the essence of the Contract and Contract Documents.

**Section 8.3.8** is added as follows:

Before starting the Work, the Contractor shall submit a Work Progress Chart, week by week, for the entire estimated period of performance of the Work. In the event it becomes apparent to the Contractor that a delay of any nature will cause a deviation from the schedule set forth in the Work Progress Chart, the Contractor shall immediately notify the Architect in writing of such fact and shall provide to the Owner and the Architect satisfactory proof of diligent efforts to rectify the delay.

**Section 8.3.9** is added as follows:

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Damages will result to the Owner by virtue of the failure of the Contractor to substantially complete this Project not later than the date set forth in the Contract. It is therefore agreed that liquidated damages as set forth in the Instructions to Bidders shall be charged and payable by the Contractor to the Owner for each calendar day, or part thereof, of delay beyond the Substantial Completion Date. The Contractor acknowledges and agrees that these damages are conclusively reasonable and are not in any way punitive. In no case shall the total assessed damages be limited to any specific fixed sum. The Owner agrees that the date when such liquidated damages shall cease to accrue shall be the date that the Architect advises Owner that the Project is substantially complete and that a Use and Occupancy Permit has been issued.

## ARTICLE 9 - PAYMENTS AND COMPLETION

**Section 9.3.1** is deleted in its entirety and the following is substituted therefor:

In accordance with the Owner-Contractor Agreement, the Contractor's itemized applications for payment for operations completed in accordance with the Schedule of Values shall be notarized, if required, and supported by such data substantiating the Contractor's right to payment as the Owner or Architect may require, such as copies of requisitions from subcontractors and material suppliers and prevailing wage payment certifications. Such applications shall reflect the required retainage, as set forth in the contract documents.

**Section 9.3.1.1** is deleted in its entirety and the following is substituted therefor:

Architect and Owner approved requests for payments, or portions thereof, will be paid by Owner within thirty-two (32) days of the Architect's receipt of the request for payment less retainage as set forth in the contract documents. The Architect must review completed applications for payment within seven (7) days of receipt of same from the Contractor. Applications for payment resulting from construction Change Directives and construction Change Orders require approval of the Board of School Directors; payment on same may be made outside of the thirty-two (32) day period set forth above, but will be paid promptly upon Board approval.

**Section 9.3.2.1** is added as follows:

In order for storage of materials offsite the Contractor must provide proof of purchase, proof of applicable insurance, must be located within a 50 mile radius of the project site, and must be visually inspected by the Owner or Architect.

**Section 9.6.1** is deleted in its entirety and the following is substituted therefor:

The Owner shall make a determination with respect to and make payment in the manner and within the time provided in the Contract Documents but no recommendation or certification of the Architect with respect to same shall be binding upon Owner.

**Section 9.7**, including its subsection, is deleted in its entirety.

**Section 9.8.1** is amended by addition of the following at the end thereof:

In no event shall the Work be deemed substantially complete until such time as the Contractor has obtained a Use and Occupancy Permit for the Project.

**Section 9.8.3** is deleted in its entirety and the following is substituted therefor:

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Upon receipt of a Certificate of Substantial Completion from the Architect, the Owner shall make its own assessment as to whether the Work is substantially complete under the terms of the Contract. Owner shall not be bound by certification by the Architect with respect to Substantial Completion. Payment to the Contractor upon Substantial Completion shall be in the same manner as progress payments.

**Section 9.10.1** is amended by addition of the following sentence at the end thereof:

Upon Final Completion of the Work and the Architect's final certificate for payment, the Owner shall make its determination with respect to Final Completion. A Certificate by the Architect with respect to Final Completion shall not be binding upon the Owner.

**Section 9.10.2** is amended by adding the following sentence at the end thereof:

The request for final payment must contain a certification of compliance with the Prevailing Wage Act.

**Section 9.10.3** is amended by deletion of the last sentence thereof.

**Section 9.10.5** is added as follows:

The making of final payment shall not constitute a waiver of any claims by the Owner, including, without limitation, those arising from:

- (a) Liens, claims, security interests, or encumbrances arising out of the Contract and unsettled;
- (b) Faulty or defective Work;
- (c) Failure of the Work to comply with the requirements of the Contract Documents; or
- (d) Terms of any special warranties required by the Contract Documents.

**Section 9.10.6** is added as follows:

The Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. Neither recommendation of any progress or final payment by the Architect nor the issuance of a certificate of Substantial Completion or Final Completion, nor any payment by the Owner to the Contractor under the Contract Documents, nor use or occupancy of the Work or any part thereof by the Owner nor any failure to do so, nor the issuance of notice of acceptability by the Architect, nor any correction of defective Work by the Owner shall constitute an acceptance of Work not in accordance with the Contract Documents (as may be amended in writing from time to time) shall constitute a release of the Contractor's obligation to perform the Work in accordance with the Contract Documents.

**Section 9.10.7** is added as follows:

At the time of signing the Agreement, the Contractor shall execute a separate agreement waiving, for himself and all subcontractors and material suppliers, the right to file any lien against the building. The waiver shall be filed with the Prothonotary prior to starting work on the Project. At the completion of the Work, the Contractor shall furnish a complete and executed Release of Liens. Final payment shall not be due until the Release of Liens is furnished to the Architect.

## ARTICLE 10 - PROTECTION OF PERSONS AND PROPERTY



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**Section 10.1.4** is deleted in its entirety and the following is substituted therefor:

Contractor agrees that it will not use nor permit to be used by any of its subcontractors, any asbestos containing materials in the Work. Contractor must submit a signed letter at the completion of the Work certifying that it has complied with this Section.

**Section 10.2.1** is amended by the addition of a new subsection as follows:

- .4 When the Contractor is using any compressed or liquefied gas, or any highly flammable liquid, the containers or tanks must be securely tied or chained to a fixed structure.

## ARTICLE 11 - INSURANCE

**Section 11.1.2** is deleted in its entirety and the following is substituted therefor:

Contractor shall purchase required insurance from a company or companies lawfully authorized to do business in the Commonwealth of Pennsylvania which company or companies must have a BEST rating no lower than "A-" and be no lower than a CLASS VII. The Contractor must secure insurance of the following types and in the following limits, at a minimum:

1. Workers' Compensation - Insurance as required by the Commonwealth of Pennsylvania or any applicable labor union contracts, whichever is higher;
2. Comprehensive General Liability - including Premises - Operations; Independent Contractors Protective; Products and Completed Operations; Broad Form Property Damage and Contractual Liability
  - (a) Combined Single Limit \$4,000,000
  - (b) Liability Insurance shall provide X, C, or U coverage, as applicable
3. Comprehensive Automobile Liability and Truck Insurance with a combined single limit of no less than \$1,000,000;
4. Umbrella Excess Liability Insurance with a minimum limit of liability of \$30,000,000 for each occurrence;
5. Professional Liability Insurance for delegated design responsibilities with a minimum limit of liability of \$1,000,000 for each occurrence.

The general liability and umbrella excess policies shall name the Owner and the Architect as additional insureds and shall include coverage for the following:

1. Explosion, Collapse and Underground Liability, as applicable;
2. Contractual Liability;
3. Products and Completed Operations Liability;
4. Owner's and Contractor's Protective Liability;
5. Blasting - in an amount sufficient to cover any damage suffered by the Owner and/or the general public;

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6. Building Collapse - in an amount sufficient to cover damages suffered by Owner and/or the general public, but no less than \$30,000,000;
7. Contractual Liability;
8. Independent Contractor's Liability;
9. Automobile Liability and Truck Insurance in an amount not less than \$1,000,000 as a combined single limit; and
10. Public Liability and Property Damage.

**Section 11.1.3** is deleted in its entirety and the following is substituted therefor:

Certificates of Insurance acceptable to the Owner shall be filed with the Owner prior to the commencement of Work. Said certificates shall contain the following provisions:

- (a) That the Owner and the Architect are included thereon as additional insureds, with the exception of professional liability; and
- (b) That the coverage afforded by the policies will not be canceled, allowed to expire or materially changed until at least thirty (30) days' prior written notice has been given to the Owner. All such insurance shall remain in effect until final payment and at all times thereafter when the Contractor may be correcting, removing or replacing defective Work in accordance with the Contract Documents. If any of the foregoing insurance coverages are required to remain in force after final payment, an additional insurance certificate evidencing continuation of such coverage shall be submitted with the final application for payment. If the Owner has any objection to the coverage afforded by, or other provisions of, the insurance required to be purchased and maintained by the Contractor on the basis of its failure to comply with the Contract Documents, the Owner shall notify the Contractor in writing within thirty (30) days of delivery of the certificates to the Owner. The Contractor shall provide to the Owner such additional information with respect to the insurance as the Owner may request. Failure of the Owner to timely object shall not constitute a waiver of Owner's rights and Contractor's obligation to provide insurance coverage as specified in the Contract Documents. Any amendments or endorsements to coverage shall be promptly furnished to the Owner by the Contractor.

**Section 11.2.1** is deleted in its entirety and the following is substituted therefor:

The Owner shall be responsible for purchasing and maintaining its own liability insurance and, at its option, may purchase and maintain such other insurance as will protect Owner against claims which may arise from operations under the Contract. Unless otherwise provided in the Contract Documents, the Owner shall purchase and maintain property insurance upon the Work at the site in the full insurable value thereof subject to such deductible amounts as may be provided in the Contract Documents or required by law.

**Sections 11.3.1, 11.3.1.1, 11.3.1.2, 11.3.1.3, 11.3.1.4, 11.3.2 and 11.3.3** are deleted in their entireties and the following **Section 11.3.1** is substituted therefor:

Owner's property insurance shall include the interests of the Owner and the Architect in the Work. Such insurance shall insure against the perils of fire and extended coverage and shall include "all risk" insurance for physical loss and damage, including theft, vandalism and malicious mischief, collapse and water damage, and such other perils as may be provided in the Contract Documents. Said insurance shall include

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losses and expenses arising out of or resulting from any insured loss or loss incurred in the repair or replacement of any insured property, including fees and charges of architects, engineers, attorneys and other professionals. If not covered under the "all risk" insurance or otherwise provided in the Contract Documents, the Contractor shall purchase and maintain similar property insurance on portions of the Work stored on and off site or in transit when such portions of the Work are to be included in an application for payment. The policies of insurance required to be purchased and maintained by the Owner shall contain a provision that the coverage afforded shall not be canceled or materially changed until at least thirty (30) days' prior written notice has been given to the Contractor. The Owner shall not be responsible for purchasing and maintaining any property insurance to protect the interests of the Contractor, subcontractors, sub-subcontractors or the Architect in the Work to the extent of any deductible amounts that are provided in the Contract Documents. If the Contractor desires to obtain property insurance coverage within the limits of such deductible amounts, the Contractor may purchase and maintain same at its own expense.

**Section 11.3.6** is deleted in its entirety and the following is substituted therefor:

The Owner shall file a copy of all policies with the Contractor before an exposure to loss may occur. If the Contractor has an objection to the coverage afforded by, or other provisions of, the policies of insurance purchased by Owner on the basis of failure of same to comply with the Contract Documents, the Contractor shall notify the Owner in writing within ten (10) days of delivery of such certificates to the Contractor. The Owner shall provide the Contractor such additional information with respect to the insurance provided by Owner as the Contractor may reasonably request. Failure by the Contractor to give such notice of objection within the time provided will constitute acceptance of such insurance purchased by the Owner as complying with the Contract Documents.

**Section 11.3.9** is deleted in its entirety and the following is substituted therefor:

Upon occurrence of any insured loss, the Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If, after such loss, no other special agreement is made, replacement of damaged Work shall be covered by an appropriate Change Order.

**Section 11.3.10** is deleted in its entirety and the following is substituted therefor:

The Owner, as fiduciary, shall have the power to adjust and settle any loss with the insurers.

**Section 11.4.1** is deleted in its entirety and the following is substituted therefor:

At the time of execution of the Agreement, the Contractor shall provide Owner with a Performance Bond and Maintenance Bond, and a Labor and Materialmen's Bond, with a surety company approved by the Owner on the specific forms for same included in the Specifications. Contractor is advised that said forms of bond are not identical to standard AIA form bonds. Said bonds shall be in an amount of 100% of the Contract price. The Contract Bonds required shall have as surety thereon a corporation duly authorized to conduct business in Pennsylvania which is satisfactory to the Owner. The bond shall be provided by a surety with a Best rating of "A-" or better.

A new **Section 11.5.1** is added as follows:

The Contractor agrees to accept, insofar as the Work covered by the Contract is concerned, the provisions of the Workers' Compensation Act of 1915, and any supplements or amendments thereto which have and which may hereafter be passed; and the Contractor will insure his liability thereunder, or file with the Commonwealth of Pennsylvania and with the Owner, a certificate of exemption of insurance from the Bureau of Workers' Compensation of the Department of Labor and Industry in accordance with the

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provisions of the Act of the General Assembly of the Commonwealth of Pennsylvania, approved July 18, 1917 (PL1083) as amended, and all other provisions of the Workers' Compensation Law now in force.

The Contractor shall provide insurance covering special hazards, as herein specified, and he shall supplement the insurance specified with additional insurance to cover himself and the Owner from any and all hazards encountered.

Neither the Contractor nor any subcontractor shall commence Work under the Contract until the Contractor has obtained all insurance required by the Contract Documents and such insurance has been approved by the Owner. The insurance certificates shall be issued covering all subcontractors as well as the Contractor.

Unless such employees are covered by the Contractor's Workers' Compensation Policy, the Contractor shall require and provide proof that each subcontractor provides Workers' Compensation insurance for all of their employees and sub-subcontractors.

#### **ARTICLE 12 - UNCOVERING AND CORRECTION OF WORK**

**Section 12.1.2** is amended by deletion of the last sentence therein and by substitution of the following therefor:

If such Work is not in accordance with the Contract Documents, the Contractor shall pay such costs unless the condition was caused by the Owner or a separate contractor in which event the Owner or separate contractor responsible shall pay such costs.

**Section 12.2.1** is amended by deletion of the first sentence thereof and by substitution of the following therefor:

The Contractor shall promptly correct Work rejected by the Architect or Owner or failing to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed or completed.

**Section 12.2.4** is deleted in its entirety and the following is substituted therefor:

If the Contractor fails to correct non-conforming or defective Work within a reasonable time, the Owner may correct it in accordance with Section 2.4.1. If the Contractor does not pay the cost of such removal and storage within ten (10) days, the Owner may dispose of the material in the most expeditious way. Costs incurred shall be charged to the Contractor by Change Order. If payments due the Contractor are insufficient to cover such amount, the Contractor shall pay the difference to the Owner.

#### **ARTICLE 13 - MISCELLANEOUS PROVISIONS**

**Section 13.3.2** is added as follows

Written notice shall be by means of electronic email.

**Section 13.4.1** is deleted in its entirety and the following is substituted therefor:

The duties and obligations imposed by the Contract Documents and the rights and remedies available hereunder to the parties hereto, and, in particular but without limitation, the warranties, guarantees and obligations imposed upon the Contractor and all of the rights and remedies available to the Owner and the Architect hereunder, shall be in addition to and shall not be construed in any way as a limitation of rights and remedies available to any or all of them which are otherwise imposed or available by law or contract, by special warranty or guarantee or other provision of the Contract Documents. The provision of this Section shall be as effective as if repeatedly specified in the Contract Documents in connection with each

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particular duty, obligation, right and remedy to which they apply. All representations, warranties and guarantees made in the Contract Documents shall survive the final payment and termination or completion of the Project and the Contract.

**Section 13.4.2** is deleted in its entirety and the following is substituted therefor:

No act or failure to act by the Owner or Architect shall constitute a waiver of any right or duty afforded either of them under the Contract Documents, nor shall any such action or failure to act constitute an approval of or acquiescence to any breach thereunder, except as may be specifically agreed in writing.

**Section 13.5.1** is amended by deletion of the last sentence thereof.

**Section 13.5.2** is amended by deletion of the last sentence thereof and by substitution of the following sentence therefor:

If such special inspection or testing reveals a failure of the Work to comply with the requirements of the Contract Documents or the requirements of law, the Contractor shall bear all costs thereof, including compensation for the Architect's additional services made necessary by such failure; otherwise, the Owner shall bear such costs and an appropriate Change Order will be issued.

**Section 13.5.3** is deleted in its entirety and the following is substituted therefor:

If such procedures for testing, inspection, or approval under Subparagraphs 13.5.1 and 13.5.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, the Contractor The Contractor shall bear all costs made necessary by such failure including those of repeated procedures, including additional testing and inspections, and compensation for the Architect's services and expenses.

A new **Section 13.8.1** is added as follows:

In the event the Owner demands arbitration pursuant to Section 4.3, such arbitration shall be decided by arbitration in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association, then obtaining, unless the parties mutually agree otherwise. No arbitration arising out of or relating to the Contract Documents shall include, by consolidation, joinder or in any other manner, parties other than the Owner, the Contractor and any other person substantially involved in a common question of law or fact, whose presence is required if complete relief is to be accorded in the arbitration. In the event of such arbitration, the award rendered by the arbiters shall be final and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

Notice of Owner's demand for arbitration shall be filed in writing with the Contractor and with the American Arbitration Association, and a copy thereof shall be filed with the Architect. The demand for arbitration shall be made within the time limit specified in Section 4.3 where applicable but in no event shall be made after the date when institution of legal or equitable proceedings based upon such claim, dispute or other matter in question, would be barred by the applicable statute of limitations.

Unless otherwise agreed in writing by the Owner, Contractor shall carry on the Work and maintain its progress during any dispute with the Owner and the Owner shall continue to make payments, except as to any disputed amount, to the Contractor in accordance with the Contract Documents.

A new **Section 13.9** entitled "Prevailing Wage Rates", is added as follows:

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### **13.9 Prevailing Wage Rates**

#### **Section 13.9.1**

The Contractor shall pay no less than the prevailing wage rates, including contributions for employee benefits, as determined in the decision of the Secretary of Labor and Industry and shall comply with the provisions of the Pennsylvania Prevailing Wage Act, approved August 15, 1961, as amended (43 P. S. § 165-1 et seq.), and the regulations issued pursuant thereto. With respect to the wages to be paid, the Contractor shall comply with the requirements specified in the Commonwealth of Pennsylvania Department of Labor and Industry Prevailing Wage Determination and General Wage Decision #PA 02-1051

#### **Section 13.9.2**

The requirements of this Article shall apply to all Work performed on the Project by the Contractor, as well as all Work performed on the Contract by subcontractors and sub-subcontractors. Contractors shall insert the stipulations required in this Article in all its contracts with subcontractors.

#### **Section 13.9.3**

No workers shall be employed on the Project except in accordance with the classification set forth in the decision of the Secretary referenced in Section 13.9.1. A schedule of prevailing wage rates is included in the Specifications.

#### **Section 13.9.4**

All workers employed or working on the Project regardless of whether any contractual relationship exists or the nature of any contractual relationship which may be alleged to exist between any contractor, subcontractor and workers, shall, not less than once a week, be paid the full amount due at the time of payment, computed at the rate applicable to the time worked in the appropriate classification, without deduction or rebate on any account, either directly or indirectly, except authorized deductions.

#### **Section 13.9.5**

For the entire period of construction, the Contractor and each subcontractor shall post the wage determination decisions of the Secretary of Labor, including the effective date of any changes thereof, in a prominent and easily accessible place or places at the Work site, and at the place or places used by the Contractor and subcontractors to pay workers their wages. This notice of wage rates shall contain the following information: (a) name of the project; (b) name of public body for which it is constructed; (c) the crafts and classifications of workers listed in the Secretary's General Prevailing Minimum Wage Determination for the project; (d) the general prevailing minimum wage rates determined for each craft and classification and the effective date of any changes; and (e) a statement advising workers that if they have been paid less than the general prevailing minimum wage rate for their job classification or that the Contractor or subcontractor are not complying with regulations of the Secretary of Labor and Industry in any manner whatsoever, that they may file a protest in writing with the Secretary of Labor and Industry within three (3) months of the date of the occurrence, objecting to the payment to any Contractor to the extent of the amount or amounts due or to become due to them for any wages for Work performed on the Project. The notice shall also state that the workers will have a civil right of action for any rate which is paid which is less than that specified in the Contract, which right of action must be exercised within six (6) months of the occurrence of the event creating such right.

#### **Section 13.9.6**

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. Only apprentices whose training and employment are in full compliance with the provisions of the Apprenticeship and Training Act, approved July 14, 1961, and the rules and regulations issued pursuant thereto, shall be employed on this Project.

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**Section 13.9.7**

Payment of compensation to workers for work performed on this Project on a lump sum basis or a piece work system, or a price certain for the completion of a certain amount of work, or the production of a certain result shall be a violation of the Prevailing Wage Act and the regulations issued pursuant thereto, regardless of the average hourly earnings resulting therefrom.

**Section 13.9.8**

Failure to pay the wage rates specified herein shall, in addition to the other penalties provided in the Prevailing Wage Act, make the Contractor liable to the Owner for a penalty in an amount equal to the difference between the wages specified in the Contract and the wages actually paid to the laborer or employee.

**Section 13.9.9**

All such penalties withheld and deducted for use of the Owner from any monies due the Contractor shall be returned to the Contractor, if any such Contractor or subcontractor subsequently pays to all laborers and employees the balance of the amounts stipulated in the Contract.

**Section 13.9.10**

Every Contractor and subcontractor shall keep an accurate record showing the name, craft and the actual hourly rate of wage paid to each of the workers and such record shall be preserved for two (2) years of payment. The record shall be open at all reasonable hours to the inspection of the Owner, the Architect and the office of the Secretary of the Department of Labor and Industry.

**Section 13.9.11**

On a monthly basis, and before progress or final payments are made of any sums due on the Project, the Contractor and subcontractors shall file statements with the Owner or its designee, in a form satisfactory to the Secretary of the Department of Labor and Industry, certifying to the amounts then due and owing from such Contractor and subcontractors, to any and all workers for wages due on account of Work, setting forth therein the names of the persons whose wages are unpaid and the amount due to each respectively. This statement shall be verified by the oath of the Contractor and subcontractors, as the case may be, that he has read such statement subscribed by him, knows the contents thereof and that the same is true to the best of his own knowledge. Nothing contained herein shall impair the right of a Contractor to receive final payment because of the failure of any subcontractor to comply with the provisions of the Prevailing Wage Act.

A new **Section 13.10** entitled "School Code" is added as follows:

**13.10 School Code**

**Section 13.10.1**

All Contract Documents will be entered into under and subject to the provisions of the Act of Assembly of the Commonwealth of Pennsylvania, Act #442 effective February 1, 1962, as amended by Act #342, approved August 9, 1963 and in accordance with the provisions of the Public School Code of 1949, P.L. 30, its amendments and supplements, and regulations of the Department of Education. The successful Bidders agree to satisfy the Board concerning all of the requirements of the laws of the Commonwealth of Pennsylvania governing bidders and contractors on contracts with a school district.

**Section 13.11.1.2** Nondiscrimination Clause - During the term of this Contract, Contractor agrees as follows:

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Contractor shall not discriminate against any employee, applicant for employment, independent contractor or any other person because of race, color, religious creed, ancestry, national origin, age or sex. Contractor shall take affirmative action to ensure that applicants are employed, and that employees or agents are treated during employment without regard to their race, color, religious creed, ancestry, national origin, age or sex. Such affirmative action shall include, but is not limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training. Contractor shall post in conspicuous places, available to employees, agents, applicants for employment and other persons, a notice to be provided by the contracting agency setting forth the provisions of this nondiscrimination clause.

**Section 13.11.1.3**

Contractor shall in advertisements or requests for employment placed by it or on its behalf state all qualified applicants will receive consideration for employment, without regard to race, color, religious creed, ancestry, national origin, age or sex.

**Section 13.11.1.4**

Contractor shall send each labor union or worker's representative with which it has a collective bargaining agreement or other contract or understanding, a notice advising said labor union or worker's representative of its commitment to this nondiscrimination clause. Similar notice shall be sent to every other source or recruitment regularly utilized by the Contractor.

**Section 13.11.1.5**

It shall be no defense to a finding of noncompliance with Contract Compliance Regulations issued by the Pennsylvania Human Relations Commission or this nondiscrimination clause that the Contractor had delegated some of its employment practices to any union, training program or other source of recruitment which prevents it from meeting its obligations. However, if the evidence indicates that the Contractor was not on notice of the third-party discrimination or made full faith effort to correct it, such factor shall be considered in mitigation in determining appropriate sanctions.

**Section 13.11.1.6**

Where the practices of a union or any training program or other source of recruitment will result in the exclusion of minority group persons, so that the Contractor will be unable to meet its obligations under the Contract Compliance Regulations issued by the Pennsylvania Human Relations Commission or this nondiscrimination clause, Contractor shall then employ and fill vacancies through other nondiscriminatory employment procedures.

**Section 13.11.1.7**

Contractor shall comply with the Contract Compliance Regulations of the Pennsylvania Human Relations Commission, 16 Pa. Code Chapter 49, and with all laws prohibiting discrimination in hiring or employment opportunities. In the event of the Contractor's noncompliance with the nondiscrimination clause of this Contract or with any such laws, this Contract may, after hearing and adjunction, be terminated or suspended in whole or in part, and the Contractor may be declared temporarily ineligible for further contracts with Owner, and such other sanctions may be imposed and remedies invoked as provided by the Contract Compliance Regulations.

**Section 13.11.1.8**

The Contractor shall furnish all necessary employment documents and records to, and permit access to its books, records and accounts by, the Owner and Human Relations Commission, for purposes of determining compliance with the Contract Compliance Regulations. If the Contractor does not possess documents or records reflecting the necessary information requested, it shall furnish such information on reporting forms supplied by the Owner or the Commission.

**Section 13.11.1.9**



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Contractor shall actively recruit minority subcontractors or subcontractors with minority representation among their employees.

**Section 13.11.1.10**

Contractor shall include the provisions of this nondiscrimination clause in every subcontract, so that such provisions will be binding upon each subcontractor.

**Section 13.12** is added as follows:

No Work shall be performed by the Contractor, any subcontractor or sub-subcontractor inside Owner's buildings unless Owner's personnel are present in the buildings at the time.

**ARTICLE 14 - TERMINATION OF THE CONTRACT**

**Sections 14.1.1, 14.1.2 and 14.1.3** are deleted in their entireties and the following **Section 14.1.1** is substituted therefor:

If the Work is stopped for a period of sixty (60) days under any order of any court, or other public authority having jurisdiction, or as a result of an act of government, such as a declaration of a national emergency making materials unavailable, through no act or fault of the Contractor or a subcontractor or their agents, or employees or any other persons performing any Work under the Contract with the Contractor, then the Contractor may, upon seven (7) additional days' written notice to the Owner and the Architect, terminate the Contract and recover from the Owner for all Work executed. No other compensation shall be awarded except as Owner in its sole discretion may determine appropriate.

**Section 14.2.1.5** is added as follows:

If the Contractor files a petition in bankruptcy, is adjudged bankrupt or if he makes a general assignment for the benefit of his creditors, or if a receiver is appointed on account of his insolvency, subject to all requirements and stipulations of the 1979 Federal Bankruptcy Law, as amended.

**END OF SUPPLEMENTARY GENERAL CONDITIONS**

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## **DIVISION 1 - GENERAL REQUIREMENTS**

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### **Section 1 - SUMMARY OF THE WORK**

A. The work includes but is not limited to:

**NEW ELEMENTARY SCHOOL; 1200 W. SWEDESFORD ROAD**

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C. The location of the project is:

**1200 W. Swedesford Road  
Berwyn, PA 19312**

## **Section 2 - CUTTING AND PATCHING**

- A. Each Prime Contractor shall be responsible for the proper fitting of work in place, and for coordination with other Prime Contractors, subcontractors, and Owner's contractors in the proper fitting and building-in of said contractor's work with that of other contractors, subcontractors and with existing conditions.
- B. The Contractor shall form any holes, chases, recesses, and openings in building construction and finish materials, for existing, new or relocated plumbing, heating, electrical, special equipment, and all other utilities or building appurtenances. This shall include verification of data, which may be indicated dimensionally on the Drawings, as well as chases and openings required, but not shown. Generally stated, the Contractor who requires such penetrations to be made shall be responsible for making the penetration and sealing around the new, or relocated utility after installation, and to repair the wall/floor/grade to original condition. In all instances where cutting is required, the Contractor shall inform the Engineer/Architect in advance. No cutting will be permitted which endangers the stability or the structural quality of the building.
1. The exception is that any openings required in the roof or exterior building envelope shall be the responsibility of the General Contractor, and shall be performed by a technician (roofing subcontractor, mason and/or sealant subcontractor) who is skilled and experienced in the required trade.
  2. Layout of openings to be completed by the Prime Contractor installing the new work and must coordinate with the General Contractor.
  3. See also the Technical Sections (024119) of these specifications for additional information. Take special note of roofing information for requirements of this trade.
  4. With regards to holes cored through exterior building envelope, the General Contractor shall not complete more than (1) hole in each exterior envelope system prior to review from Owner or Architect.

## **Section 3 - DEMOLITION**

- A. Description of Work:
1. The extent of demolition is described herein and shown on the Drawings.
  2. Demolition includes removal and disposal of demolished materials, rubbish, abandoned equipment, flotsam and jetsam, etc., in the area of new construction, renovations and sitework; removal of miscellaneous fixed items presently located on the building site; and excavation for structures as shown on the Drawings.
  3. Additionally, it must conform to the regulations of Tredyffrin Township.
  4. It is the intent that the Contractor will remove all items or equipment which will impede or restrict providing a space, surface or area as it was intended to be, or for the work of another contractor, subcontractor or Owner. This will include pipes, conduits, angles, dirt, debris, equipment, etc., even though they may not be exposed or shown on the Drawings.

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- B. Responsibilities of Contractors - Demolition: The project includes renovations of the existing building and equipment. As clearly as possible, demolition responsibility is divided as follows:
1. Where required, demolition of electrical conduits, and other items described in Division 26, which are considered in the trade to be a part of electrical construction shall be demolished and removed from the site by a licensed electrical contractor.
  2. Demolition of ducts, fans, radiators, pumps, boilers, etc., and other items described in Division 23, which are considered in the trade to be a part of mechanical or HVAC construction, shall be demolished and removed from the site by the mechanical contractor.
  3. Demolition of plumbing fixtures, piping, valves, etc., which are considered in the trade to be a part of plumbing construction, shall be demolished and removed from the site by the plumbing contractor.
  4. When demolition is inferred, described or drawn as a necessary step to provide for the renovations, then this shall be included in the related contract.
  5. Interior and exterior walls, ceilings, soffits, partitions, stairs, floors, building appurtenances etc., shall be demolished and removed from the site by the General Contractor. It is the intent that this includes all material considered, in the trade, to be a part of general construction.
  6. Chases, holes, openings, etc., required by any of the subcontractors, in existing construction, shall be opened, closed and reinforced by the contractors requiring the opening, except that any openings in the existing roof, roof deck, and building envelope shall be made and closed by the General Contractor and roofing subcontractor. See also Section 2 of these General Requirements.
  8. Routes of ingress and egress, for bringing in materials and equipment and for removal of rubbish from areas in the existing site where renovation work is in progress, shall be subject to the restrictions of and in accordance with the instructions of the Architect and Owner and strictly in accordance with local and state laws and ordinances, and all authorities having jurisdiction.
  9. Pollution Controls: Contractors shall use water sprinkling, temporary enclosures, sweeping compounds, exhaust fans and other suitable methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level. Temporary enclosures, for containing dust, dirt and debris must conform to requirements of authorities having jurisdiction. No additional compensation will be paid for complying with this provision.
  10. Contractors shall comply with governing regulations pertaining to environmental protection. Water will not be used when it may create hazardous or objectionable conditions such as ice, flooding or pollution.
  11. Contractors shall clean adjacent areas and improvements of dust, dirt, and debris caused by demolition operations, related to their scope of operations, as directed by the Architect, and return adjacent areas to conditions existing prior to the start of the work. Such cleaning shall occur daily.
  12. Except where indicated otherwise on the Drawings and specifications, or materials, or items of equipment to be retained by the Owner, all dismantled materials shall become the property of the Contractor and shall be removed from the premises in accordance with all laws, codes and regulations, and all authorities having jurisdiction. Recycling of materials and equipment not expressly required is strongly recommended.
  13. Demolition may proceed in any safe, feasible manner.
    - a. Masonry walls shall be demolished in small sections. Remaining sections will be properly braced during the work and at the end of each day.
    - b. Windows and door frames shall not be removed until the work has progressed down to their elevation in the walls.
  14. Any contractor operating in the area of an existing utility line or any operating service line shall be responsible for maintenance of that line during the operation or relocation in order to avoid interruption in operation. Any break in any line will be repaired according to the requirements of the code or the utility company by the contractor responsible for the break. All contractors doing excavating or demolition should carefully investigate the areas to be excavated or demolished prior to beginning the work. Contact **Pennsylvania One Call System, Inc., 800-242-1776**, a minimum of three days prior to any digging operation, to locate underground utility lines, per

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- Pennsylvania Law. It is the responsibility of the contractors doing the work to accurately locate all existing lines.
15. Refer to related sections of the Specifications for further information on this phase of the work.
  16. Where demolition is performed and surfaces are left uneven, with holes, unpainted, or any other blemish, the contractor doing the demolition will be required to patch and repair that area to an equal level of finish, color and texture as the surrounding surfaces. The work must be performed by a contractor skilled in that trade.
  17. Contractors responsible for protection of existing building elements that are to remain. Contractors responsible for costs to repair any damaged building elements to remain. Each Prime contractor responsible for protection of existing conditions within their scope of work, unless otherwise identified on the drawings or specifications.

#### Section 4 - PERMITS, LICENSES, AND CERTIFICATIONS

- A. The **owner** shall apply for and procure all applicable permits and licenses and give all notices necessary for the commencement of their work. It shall be the Owner's responsibility to pay for a local "building" permit, which will be obtained from and required by the Tredyffrin Township. The contractor shall be required, however, **to coordinate with owner**. All other permits and contractor registration fees and licenses shall be obtained and paid for by the contractors. The contractors are responsible for contacting the Township and Chester County to determine all permits, licenses, applications, etc. which are required as part of this project.

#### Section 5 - PROJECT MEETINGS

- A. Regular job progress meetings will be held weekly, at which the Contractor shall be present, for the purpose of coordinating the work. If particular subcontractors would add needed information at a meeting, then that subcontractor should be present. The contractors' representative attending these meetings shall be fully authorized to represent said contractor in the matters brought before the meeting and shall have a full understanding of the field activities of both the contractor's own forces and those of the contractor's subcontractors. The Architect may, at the Architect's discretion, require each contractor to be represented by both their project manager and their construction superintendent (foreman). The Architect shall publish minutes of the meeting and distribute them to all interested parties.
- B. **All Prime Contractors** shall submit in writing at each job meeting a list of work completed during the previous week, or time period between job meetings, and the work proposed to be completed during the subsequent week. Any and all verbal instructions from the Architect received by the Contractor during the week should be noted on the Contractor's set of drawings and brought up at the next meeting to become a matter of record.
- C. A job information sheet will be given to the Contractor at the pre-construction meeting, which will cover minor responsibilities of the Contractors such as number of submissions, emergency numbers, procedures, etc., as noted in these General Requirements and the Supplementary General Conditions contained in these Specifications.
- D. All Prime Contractors shall submit Monthly reports (shall be submitted with Application for payment) A draft monthly report shall be submitted for review and approval of format and content. At a minimum, the following should be included:

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1. Cost Event Log
2. Insurance Certificate Log
3. Request for Information Log
4. CPM Schedule Update Showing Critical Path (with Baseline) – submitted by Project Coordinator Only.
5. Submittal Log (identifying current status, purchasing timeline, onsite delivery)
6. Manpower Report
7. Safety Issues/Resolutions

**Section 6 - JOB SITE ADMINISTRATION**

- A. Access to the construction sites shall be as directed by the Owner and the Township. If necessary for safety, movable barricades to be furnished by the General Contractor and used by the contractors. Establishing and maintaining this access will be the responsibility of the General Contractor.
1. Contractors will be required to sign-in and sign-out when entering or leaving the site.
  2. The District has a Security Guard assigned the site. Every day Security Guard will validate Background Checks, have contractors sign-in, Issue and ID that must be returned at end of day
- B. It is the intent that at times when the contractors are not reliably represented on the site, they shall be responsible for securely closing all openings and for locking any other possible means of access which are being used in connection with their construction contract.
- C. Offices, sheds, toilets, lay down areas, mock-ups, etc., shall not be located without prior approval of the Owner and Architect. All supplies and/or equipment delivered to the site must be stored, according to the manufacturer's written recommendations, outside the existing building unless prior approval is granted by the Owner and the Architect. The storage of supplies and/or equipment must be carried out so as not to void warranties, and to protect from damage and vandalism.
- D. Work Area: The Contractor shall keep his operations and storage of materials within as small an area as any one time as is feasible. He shall meet with the Architect and Owner to establish the work area and notify them and receive their approval for any required changes. It shall be the Contractors' responsibility to study the proposed schedule included in the Contract Documents and make the necessary allowances and preparations for safe operations. Any relaxation of this schedule must be agreeable to the Owner, Contractor and Architect.
- E. The Contractor shall be responsible for the behavior of such Contractor's workmen. Inappropriate language will not be tolerated and will be cause for removal from the project. Contractor social interaction with students will not be tolerated and will be cause for removal from the project. Use of "Boom Box" radios will not be allowed. Smoking is not permitted in or on school district property.
- F. Notice to the Owner shall be made and all provisions agreed upon before commencing any movement of men or materials, or performance of any of the work outside of the protected limits. Normal traffic area must remain unobstructed, and any required change in these travel patterns must be worked out with the Owner and Township beforehand.
- G. Except for Second-Shift hours, provided for the in the contract, the Contractor must reimburse the Owner and Owner's Representative for security beyond the normal work hours, 7:00 AM through 3:30 PM, Monday though Friday. See Section 12 of the Instructions to Bidders.

The cost is:	Monday through Friday	\$64.00 /hour
	Saturday, Sunday, and Holidays	\$85.00/hour

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- H. Contractor's shall provide a list of phone numbers where the job superintendent and two responsible members of the organization can be reached in an emergency by the Owner or the Architect. These contact numbers shall include 24 hour, 7 days per week contacts for use in an emergency. If contractor does not respond to an emergency, the Owner reserves the right to respond and charge the Contractor for any costs incurred by the School District.
- I. Each Prime Contractor shall maintain a full-time site superintendent throughout the entire course of construction (from the start of the work through completed punch list), and who shall be present on site at all times the Contractor's staff, subcontractors, or other Prime Contractors' staff or subcontractors are present. The Contractor shall maintain the same superintendent from the start of the project until finished closeout. Regular contractor's job site superintendent and work staff must sign in and out daily with the Owner's representative.
  - 1. Each Prime Contractor shall keep a written log showing the condition of the existing building, daily weather conditions, condition of the new work, and schedule of progress. In addition, this log shall include lists of workmen on site, identified by trade. This log shall be available to the Owner upon request at any time throughout the work and shall be included in the Closeout Materials provided at the end of the job.
  - 2. Shop drawing log requirements are described below.
  - 3. Weekly Superintendent meetings.
- J. Contractors to submit a "Request for Shutdown" to Owner 7 days in advance, via email.

#### Section 7 - CONSTRUCTION SCHEDULE

- A. The **General Contractor** will be responsible for producing and distributing a comprehensive project schedule, within **2 (two) weeks after the Award of the Project**, to the Owner, the Architect, and to all other Prime Contractors. All contractors must review the schedule and incorporate their schedules on the General Contractor's master. A final schedule, revised by the General Contractor, will be derived from this input, and distributed to the parties noted above, **no later than 4 (four weeks) after Award of the Project**. Schedule Updates to be provided on a weekly basis.
- B. **All Prime Contractors** shall provide a list of subcontractors, subsubcontractors, material suppliers and/or installers, and proposed dates for submissions of shop drawings. The list of subcontractors shall be submitted within two weeks of the contract award.
- C. A shop drawing schedule will be required of each Prime Contractor, to indicate length of delivery time, any long lead items, submission date, a reasonable turn around time, and expected delivery date of the product and approximate date(s) for incorporation into the work.
- D. Each Prime Contractor shall maintain a Daily Log of construction activities, entrance and commencement of trades on site, deliveries, and agreements made. Notation shall be included of inspections made by authorities having jurisdiction, or by the Owner's inspection and testing agency. In addition, when there are items for which time and materials calculations must be determined, the Daily Log shall reflect the time for each workman expended directly to address the item.
- E. Primes working overtime and shift work is at Prime Contractors expense and not additional cost to TESD; including work performed after substantial completion
- F. Project Coordinator will prepare a preliminary combined Contractors' construction schedule for entire Project, which is included in the Contract Documents. Project Coordinator shall create a detailed CPM schedule.

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1. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
  2. Refer to Specification Section 01410– Project Coordination Multiple Primes Contracts for additional information.
- G. When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

#### **Section 8 - CONSTRUCTION NOISE CONTROL**

- A. As defined by the Township Ordinance

#### **Section 9 - SHOP DRAWINGS, SAMPLES, & SPECIFICATIONS**

- A. Shop drawings required by Article 4 of the General Conditions shall be checked, dated, stamped and signed by the submitting contractor prior to issuing them to the Architect/Engineer. When submitted, the contractor asserts that they conform to measurements at the site, the requirements of the contract documents, and the requirements of all trades whose work must be coordinated with that shown on the Drawings.
- B. Emphasis shall be on the expediting of shop drawings of long delivery items and early installation work, so that no delays will occur. Work covered by shop drawings shall not be started until final review has been made, is given by the Architect/Engineer, and the final, reviewed shop drawings are in the hands of the Contractor.
- C. Any omission by the Architect during the shop drawing review does not relieve the Contractor from conforming with the Contract Documents, Codes, laws and Manufacturer's Requirement.
- D. Submissions shall provide all information for a product to be completely and successfully ordered. All required information, including, but not limited to, samples, color samples of actual material (printed colors are not acceptable), textures, patterns, specifications, drawings, warranties, installation instructions, safety data sheets, etc., must be provided at the time of first submission.
- E. A current set of shop drawings and submittals with the Architect's approval stamp will be kept at the site at all times.
- F. The superintendent shall read the Specifications carefully in advance of the entry of the trade and/or material on the job. Each Prime Contractor shall provide Specifications for their Subcontractors' use. Superintendent shall confirm that Subcontractors have read Specifications prior to the starting of their work.
- G. All manufacturer's specifications should be kept on file at the job site. Provide material safety data sheets on all applicable products.
- H. See also Section 013300 – Submittal Procedures of these Specifications.

#### **Section 10 – INSPECTIONS & TESTING**



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- A. The Owner will engage testing agencies for Environmental, Concrete and Steel Testing and Inspection, as required.
- B. Each Prime Contractor will provide Pre-Construction testing of materials if required, other than listed above.

**Section 11 - LAYOUT DATA**

- A. Before ordering material or doing any work, **the Contractor shall verify all measurements & elevations at the site.** No extra compensation will be allowed because of difference between actual measurements and dimensions shown, but such difference shall be referred to the Architect/Engineer for consideration before proceeding with the work.

**Section 12 - PARKING**

- A. Contractor's employees' cars shall be parked in a location approved by the Owner of the site. The contractors who park on the street, if allowed, shall be considerate of the residential neighbors who are paying for the project. All local parking regulations will be adhered to.
- B. Refer to Logistics Plan on Site/Civil Drawings for additional information.

**Section 13 - TEMPORARY ELECTRICITY**

- A. Refer to Specification Section 01410 – Project Coordination Multiple Primes Contracts for additional information.
- B. Electrical Contractor shall extend electric service to a point convenient to each of the areas in which work will be performed. This location may be within the area of construction or immediately outside the area; in any case, it shall be a location acceptable to the General Contractor. The service to be provided, unless otherwise specifically mentioned in the Contract Specifications, shall be as required by for the equipment and as available from the existing facilities. This service shall be installed within three days after written request have been made to the electrical contractor, by a contractor requiring such service.
- C. Electrical Contractor to provide and pay for all maintenance, servicing, operation, and supervision of lines.
- D. Electrical Contractor to provide temporary wiring throughout the building, properly insulated and installed in a safe and workmanlike manner and per applicable codes. All maintenance for the system throughout the project shall be included.
- E. Electrical Contractor to provide 120V quad GFCI receptacles every 40 feet each floor, at a minimum. Receptacles shall conform to NEC and rules and regulations prescribed by OSHA as well as other agencies having jurisdiction. When such codes or regulations are inconsistent, the more stringent will prevail.
- F. Electrical Contractor shall extend electrical service to all construction and owner's trailers on the site as determined during the first job meeting.
- G. In addition to the electrical service provided for above, the electrical contractor shall install one work light in each room and shall service the lights and supply lamps as required.
- H. Temporary lighting and power should be provided in each phase within 5 days.
- I. Electrical Contractor shall provide a 100kW diesel generator that will need to run 24x7 during power outage period(s) for the electrical service relocation work.

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- J. When the electrical lines and temporary lighting are no longer required, they shall be removed.
- K. The Owner will continue to pay for the electricity usage during construction.

**Section 14 - TEMPORARY HEAT**

- A. Refer to Specification Section 01410 – Project Coordination Multiple Primes Contracts for additional information.
- B. Each Prime Contractor is responsible for temporary heating, cooling, and ventilation as needed for their scope before weathertight enclosure of entire building is complete. Usage charges are responsibility of the owner. Where forbidden by codes and safe construction standards, temporary heating equipment fuels shall not be stored within the 'buildings'. Adequate temporary heating level must be maintained as per manufacturers requirements, but no temporary heating units can be left unattended while they are within the buildings.
- C. Mechanical Contractor is responsible for temporary heating, cooling, and ventilation after weathertight enclosure of entire building is complete and Owner will pay utility-use charges.
- D. The use of new heating or HVAC units for temporary heat or cooling will not be permitted, unless given written approval by the Architect, engineer, and owner. If this approval is granted, the equipment will be maintained by the contractor. Filters will be changed on a weekly basis and the warranty for the unit and its components will not start until the substantial completion date. All ducts and the unit will be cleaned at the end of the job to the satisfaction of the owner.

**Section 15 - TEMPORARY WATER**

- A. Plumbing Contractor to provide and maintain temporary water service from existing building for use during construction. Contractor shall provide two (2) ¾" hose bib connections. Locations to be coordinated with needs of all primes. Remove temporary waters service back to the source when directed by Owner and/or Architect.
- B. The source of the water shall be coordinated and approved by the owner.
- C. Electrical Contractor to provide all heat tracing associated with the Temporary Water as specified in plumbing primes scope of work.

**Section 16a – TEMPORARY FIELD OFFICE**

- A. The GC Prime Contractor shall provide a field office construction trailer for use by the owner. The trailer shall be setup prior to the start of construction and removed after the completion of construction. At a minimum, the trailer shall be/include:
  - 1. Single wide (14'x45') with Furniture
  - 2. One office space
  - 3. Large conference room meetings
  - 4. Steps and skirting
  - 5. Heat and Cooling
- B. The GC Prime Contractor shall provide a field office construction trailer. The trailer shall be setup prior to the start of construction and removed after the completion of construction. At a minimum, the trailer shall be/include:

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1. Single wide (14'x45') with Furniture
  2. Large conference room for project meetings
  3. Steps and skirting
  4. Additional trailers acceptable with owner and architect approval.
  5. Heat and Cooling
- C. Each Prime contractor may place up to 1 field office trailer, if necessary. Primes must submit request to owner/architect for approval.
- D. All trailer sizes, interior layout, and position on site to be reviewed by owner and architect prior to delivery and installation.
- E. The Electrical Contractor shall provide temporary electric service for all field office trailers. This shall be provided within 3 days of installation of trailer. Remove the temporary service at the completion of the project when directed by Owner and/or Architect.

#### **Section 16 - TEMPORARY SANITARY FACILITIES**

- A. The Contractors will not be allowed to utilize the toilet facilities at the site. The General Contractor shall provide temporary toilet facilities, and in a location agreeable to the Owner and the Township and complying with State and Local laws and Board of Health.
- 1) Maintain, service and clean facilities on a regular basis but not less than twice per week.
  - 2) Quantity of toilets facilities shall be sufficient for use by all contractors and subcontractors' personnel.

#### **Section 17 – TELEPHONE CONTACT**

- A. Each Prime Contractor shall furnish cell phone contact information for their Project Manager and Field Site Superintendent, and Foreman at a minimum.

#### **Section 18 - PROJECT IDENTIFICATION**

- A. Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Provide Project identification signs as indicated on Drawings.
  2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
  3. Provide temporary, directional signs for construction personnel and visitors.
  4. Maintain and touchup signs so they are legible at all times
- B. No nameplates, signs, bills, advertising or displays will be allowed at the site under construction.

#### **Section 19 - CONSTRUCTION FENCES**

- A. Refer to Site/Civil Drawings for additional information.
- B. Laydown and Storage areas must be securely enclosed with a minimum of 6' high chain-link fence. Location shall be coordinated with the Owner and shall be acceptable to Authorities Having Jurisdiction. Each Prime Contractor shall be responsible for securing and paying for fencing. To the extent possible, Contractors are asked to work together to limit the amount of fencing required.
- C. Within five (5) days after Notice to Proceed commence with the installation of site fencing inlet protection and silt fencing. Work to be completed within ten (10) calendar days

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- D. Any contractor damaging or removing portions of the fence shall be obligated to repair the fence and shall pay any associated cost.
- E. Project Coordinator shall remove the fence and/or barriers when they are no longer required. Project Coordinator shall coordinate and obtain approval from owner prior to the removal of any fence and barriers.

#### **Section 20 - TREE AND PLANT PROTECTION**

- A. Refer to Site/Civil Drawings for existing vegetation removal scope and additional information.
- B. No existing vegetation shall be cut, pruned, tied or removed unless and until the approval of the Civil Engineer and Owner is obtained. The contractors shall be held responsible for any such damage as a result of his contract. The Architect/Engineer shall determine responsibility for plant damage, and therefore who shall replace or restore the damaged tree or shrub. It is the Owner's intent that existing trees be carefully protected in the area of construction. Each Prime Contractor shall be responsible for protection associated with scope of work with a sound, rigid fence as described in the landscape documents. Lawns damaged by construction activities shall be repaired with sod and established by the Contractor before turning over to the owner.

#### **Section 21 - PRODUCTS**

- A. Proprietary Articles - In such case where fixtures, materials, or appliances of a special brand are specified without specifically stating that an approved equal may be substituted for them, it shall be understood that articles which are, in the opinion of the Architect/Engineer, of a quality necessary to meet the specifications, or superior in every respect to the originally specified fixture, material or appliance, may be substituted for them upon the written request by the Contractor and written consent by the Architect/Engineer. See also Section 16 of the Instructions to Bidders, and Section 22 below.
- B. Manufacturers' Specifications - Mention of a product by a specific name shall imply application of the manufacturer's specifications, except where more stringent specifications are mentioned elsewhere. A copy of the manufacturers' specifications, which apply shall be kept available at the job site. This shall include association specifications having bearing upon related work and work at the site but may be excluded where such qualifications concern only shop-made materials.
- C. Substitution of Alternative Materials - To the extent deemed necessary by the Architect/Engineer, producers of alternative materials will be required to furnish samples, literature, test and performance data, record of their installation, names of owners, Architect/Engineers, contractors and subcontractors as references, statement of current financial condition, and any other appropriate technical information. Refer to Instructions to Bidders, Section 16, for the procedure to be used for submission of Substitutes, and to Section 22 below.

#### **Section 22 - STANDARDS OF QUALITY**

- A. Standards of quality are established by description, by reference to trade names, or by reference to manufacturers' names. The various materials and products specified in this specification by name or description are given to establish a standard of quality and of cost for bid purposes.
- B. Where the term "or alternatives of the quality necessary to meet the specifications" may occur it acknowledges the presence of many similar products, unknown or known but not named, which may

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receive consideration by the Architect/Engineer where an advantage to the Owner might result, such as lower cost, better quality, better color selection, better delivery, or other particulars. Do not base value of the work upon products not named in such instances. Consideration of such alternative products will be given based on difference in contract price where a price difference exists.

- C. These provisions are intended to place all bidders on an equal footing; it is not intended to make the documents restrictive, but rather to establish an absolute minimum standard.

### **Section 23 - CLEANING UP**

- A. Cleanup is to receive constant attention from start to finish.
1. Each Prime Contractor shall be responsible for securing and paying for dumpsters and trash bins as required for the disposal of demolition and construction debris during the project. To the extent possible, Contractors are asked to work together to limit the quantity of dumpsters required on site at any one time, however, each Prime Contractor remains responsible for the debris of its trade.
    - a. The Project Coordinator shall be responsible to coordinate the layout of the construction yard built on site, for exterior material storage, contractor offices, dumpsters, etc. The Project Coordinator shall receive space needs within the yard from all other Prime Contractors and shall issue a coordination drawing to the Owner, Architect, and other Prime Contractors, for the purpose organizing the use of this area and for maintaining this area as small as possible on site.
- B. The Contractors are responsible to remove Debris and Trash to the dumpster daily.
1. Owner to notify contractors in writing regarding any failure to clean up site accordingly. If the Contractor fails within seven (7) days after written notice from Owner to correct failures, the Owner may correct, remedy or complete such deficiency. All direct and indirect costs of the Owner exercising such rights shall be charged against the Contractor in an amount verified by the Architect and a Change Order shall be issued incorporating (a) the necessary revisions in the Contract Documents and (b) a reduction in the Contract sum.
- C. The Contractors shall protect all surfaces, fixtures and equipment in the area of the work, from dust and debris. If required, the contractor shall clean such surfaces, fixtures and equipment, at the conclusion of the work or intermittently as directed by Owner and/or Architect.
- D. The Contractors shall protect all exterior surfaces subject to damage by work vehicles, construction trailers, and/or materials storage. Any damage to hardscape (asphalt, concrete, etc.) and/or lawns and landscape, shall be repaired by the responsible Contractor to a condition equal to, or better than the original, undamaged surface, and at no additional cost to the Owner.

### **Section 24 – STRUCTURAL OR MEP DEFECTS**

- A. Contractors shall report in writing to the architect any structural, mechanical, plumbing, or electrical defects that are exposed.
- D. No corrective work shall take place before the solution is reviewed with the Architect.

### **Section 25 - EXPOSED MEP COMPONENTS**

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- A. Any and all mechanical, electrical, and plumbing that is to be exposed in any occupied and/or furnished space shall require written approval from the Architect prior to its installation. The Architect will further direct the location, attachment method, and finish treatment, that these components require as a result of being approved to be exposed.

#### **Section 26 - RETAINAGE**

- A. Retainage on completed work shall be made on each monthly payment in the amount of ten (10%) percent of the amount due the Contractor until 50% of the contract is completed.
- B. When the Contract is fifty (50%) percent completed, the retainage on completed work thereafter on each monthly payment shall be in the amount of five (5%) percent of the amount due the Contractor; provided that the Contractor is making satisfactory progress and there is no specific cause for greater withholding.
- C. Provided, however, that in the event that a dispute arises between the contracting body and the prime contractor, which dispute is based upon increased costs claimed by the Prime Contractor occasioned by delays or other actions of others, additional retainage in the sum of one and one-half times the amount of any possible liability may be withheld until such time as a final resolution is agreed to by all parties directly or indirectly involved, unless the Contractor causing the additional claim furnishes a bond satisfactory to the contracting body to indemnify such contracting body against the claim. However, all such monies retained by the contracting body may be withheld from the Contractor until substantial completion of the Contract.

#### **Section 27 - TOUCH-UP AND REPAIR**

- A. It is the responsibility of the Contractors to walk the project with the Owner and the Architect prior to the start of any work in an area to establish the existing conditions prior to any possible damage. Damage to a part of the existing project, which was not present at the start, which will remain, will be repaired or replaced by the Contractor doing the damage at no cost to the Owner.

#### **Section 28 - ACT 287**

- A. In accordance with Commonwealth of Pennsylvania Act 287, the Contractor must notify the appropriate underground utility companies at least 72 hours before any excavation is begun. See Section 3, Paragraph B, Item 14, of this General Requirements for the Pennsylvania One Call System, Inc. information.

#### **Section 29 - PUMPING AND BAILING**

- A. The General Contractor will be responsible for removing accumulations of water at all times from the work while the work is in progress, regardless of whether caused by nature, accident, or otherwise. The water must be removed promptly and continuously, if necessary, in order to maintain the progress of all contractors.

#### **Section 30 - WEATHER AND PROTECTION OF WORK**

- A. The Contractor shall furnish and maintain proper protection for his work, existing facilities, and new and existing materials from damage by cold or inclement weather or windstorm, and if, in the opinion of the Architect/Engineer, any of the work or Contractor's materials, or other portions of the building, shall have

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been damaged or injured by reason of Contractor's failure to provide such protection, such damage or injury shall be rectified by that Contractor at his own expense (less any amount collectible under any insurance coverage in effect). There shall be no limit to the scope of this protection.

- B. When temporary flooring protection is required for the scope of work, or when dictated by owner or architect, the general contractor is required to provide (at a minimum) Masonite protection board with taped seams for floor protection, at no extra cost to the owner. The General Contractor is responsible for installation and removal of temporary floor protection.

### **Section 31 - EQUAL OPPORTUNITY**

- A. Prime Contractors and all subcontractors, performing any portion of the work, shall not discriminate against any employee or applicant for employment because of race, religion, color, sex or national origin. Contractor shall take affirmative action to ensure that applicants are employed, and the employees are treated during employment, without regard to their race, religion, color, sex or national origin. Such action shall include, but not be limited to, the following: employment, demotion or transfer; recruitment of recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. Contractors agree to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of non-discrimination.
- B. Contractor and all subcontractors shall in all solicitations or advertisements for employees placed by them or on their behalf, state the all qualified applicants will receive consideration for employment without regard to race, religion, color, sex or national origin.

### **Section 32 - PUBLIC WORKS EMPLOYMENT VERIFICATION ACT REQUIREMENTS**

- A. The Contractor and every subcontractor performing work under the contract shall utilize the E-Verify Program (EVP) operated by the United States Department of Homeland Security to electronically verify the employment eligibility of each new employee hired after January 1, 2013.
- B. The Contractor, as a precondition of the contract, shall submit the Public Works Employment Verification Form to the District along with its Payment Bond, Performance Bond, Certificates of Insurance and Form Contract.
- C. Every subcontractor shall submit a completed Public Works Employment Verification Form to the District prior to performing work on the Project.
- D. During the term of the Contract, each new employee hired by the Contractor, regardless of whether the employee will be working onsite or offsite of the Project, shall be verified within 5 business days of his or her start date.
- E. During the Project, a new employee hired by a subcontractor, regardless of whether the employee will be working onsite or offsite of a public work or otherwise, shall be verified within 5 business days of his or her start date.
- F. Subcontracts between the Contractor and its subcontractors and between subcontractors of any tier and their subcontractors are required to contain notification of the applicability of the Act, information regarding the use of EVP and reference to the Department's web site at [www.dgs.state.pa.us](http://www.dgs.state.pa.us) to obtain a copy of the Form.

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- G. The Contractor and all subcontractors shall cooperate with the Department during an investigation or audit arising under the Act.
- H. The Contractor and every subcontractor shall maintain documentation of continued compliance with the Act by utilizing the EVP for new employees hired throughout the duration of the public work contract.

**Section 33 - AS BUILT DRAWINGS AND CLOSE OUT BINDERS**

- A. All required documentation shall be furnished to the Owner and Architect in electronic form, in addition to the paper copy described below. Provide all information on USB Drive (2 total).
- B. It will be necessary to produce "As-Built" drawings, at completion of the project, in order to receive final retainage payment.
- C. The Contractor will be responsible for documenting their respective work as well as their subcontractors' work. A job record of material delivery dates, commencement of significant installations, and other job issues shall be turned over to the Owner at the completion of the project.
- D. The Contractor shall always keep said contractor's project drawings up to date, marking final location data on them in colored pencil or ink. When requested, they shall mark all location and dimension data on a clean set of base drawings and send them to the Architect, certifying on the prints that the information shown has been verified and found correct. At the conclusion of the project, the Contractor will turn over to the Architect the original record set of field verified "As built" drawings and one exact copy.
  - 1. The Contractor shall mark the cover sheet of the "As-Built" set of drawings with their company name, address, phone number and website address, as well as with the title, "Contractor's As-Built Drawings".
- E. At the conclusion of the project the Contractor shall turn over to the Owner one (1) three-ring binder containing the following materials:
  - a. Written warranties on all equipment and material.
  - b. Specification sheets provided by manufacturers for all equipment and material (same as final, approved submittal).
  - c. Equipment and material maintenance manuals.
  - d. Final project accounting report indicating all change orders and final costs.
  - e. Executed Release of Liens.
  - f. See also General Conditions, Item 9.10.2 for additional Closeout Requirements.

**END OF GENERAL REQUIREMENTS**



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**FORM OF AGREEMENT**

**TREDYFFRIN/EASTTOWN SCHOOL DISTRICT  
AND CONTRACTOR**

This agreement, made this            day of            , between The Tredyffrin/Easttown School District, 940 West Valley Road, Suite 1700, Wayne, Pennsylvania 19087, and the "Contractor".

The Contractor is:

The Project is:            New elementary school; 1200 W. Swedesford Road

The Architect is:            Heckendorn Shiles Architects  
347 E Conestoga Rd  
Wayne, PA 19087

The Owner and Contractor, intending to be legally bound hereby, agree as set forth below.

**ARTICLE 1  
THE CONTRACT DOCUMENTS**

The Contract Documents consist of this Agreement, the Instructions to Bidders, the Conditions of the Contract (General, Supplementary, and other Conditions), the Drawings, the Specifications, all Addenda issued prior to and all Modifications issued after execution of this Agreement. These form the Contract, and all are as fully a part of the Contract as if attached to this Agreement or repeated herein. An enumeration of the Contract Documents appears in Article 7. The Contract Documents represent the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral.

**ARTICLE 2  
THE WORK**

The Contractor shall perform all the Work required by the Contract Documents.

**ARTICLE 3  
TIME OF COMMENCEMENT AND SUBSTANTIAL COMPLETION**

The Work to be performed under this Contract shall be commenced as soon as this Contract has been executed and all of the start up documents, including but not limited to insurance, bonds, and permits, have been received and accepted in accordance with the Contract Documents. Subject to authorized adjustments, the phase dates of completion are as noted below. The date of Final Completion for the entire Project is **April 9, 2027**. See also the Instructions to Bidders for items of coordination that require specific Interim Deadlines.

All contractors and subcontractors shall cooperate with each other and shall coordinate their activities and work so that the entire program of construction can be completed on or before the date set forth above.

**ARTICLE 4  
CONTRACT SUM**

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The Owner shall pay the Contractor in current fund for the performance of the Work, subject to additions and deduction by Change Order as provided in the Contract Documents, the Contract Sum of

\$ \_\_\_\_\_.

The Contract Sum is determined as follows:

Base Bid \$

Alternates \$

TOTAL \$ \_\_\_\_\_

#### ARTICLE 5 PROGRESS PAYMENTS

Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided in the Contract Documents for the period ending the last day of the month as follows: Provided that an Application for Payment is received by the Architect not later than the last day of the month, the Owner shall make payment to the Contractor not later than the last day of the next month. If an Application for Payment is received by the Architect after the application date fixed above, payment shall be made by the Owner not later than thirty-two (32) days after the Architect receives the Application for Payment.

Each Application for Payment shall be based upon the Schedule of Values submitted by the Contractor in accordance with the Contract Documents. Payment on Application for Payment approved by the Architect and Owner shall be made as follows: Ninety percent (90%) of the portion of the Contract Sum properly allocable to labor, materials and equipment incorporated in the work and ninety percent (90%) of the portion of the Contract Sum properly allocable upon in writing, for the period covered by the Application for Payment, less the aggregate of previous payments made by the Owner.

Upon completion of fifty percent (50%) of the Work under the Contract, for payments thereafter, ninety-five percent (95%) of the portion of the allocable Contract Sum, as set forth in this Article, shall be paid upon properly approved Application provided there is no specific cause for greater withholding arising thereafter.

Upon Substantial Completion, the retainage shall be released, and the Contract Sum shall be paid, less (1) 1.5 times the estimated cost to correct or complete any incomplete or incorrect work noted in the Punch List, (2) the sum of any liquidated damages due to the Owner as a result of the Contractor's failure to meet the applicable completion deadline, and (3) any other proper causes for withholding. Reduction or limitation of retainage, if any, shall comply with Pennsylvania Statute 62 Pa.C.S.A. §3901 et seq.

Payments due and unpaid under the Contract Documents shall bear interest at the rate of six percent (6%) from the date payment is due.

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ARTICLE 6  
FINAL PAYMENT

Final payment, constituting the entire unpaid balance of the Contract Sum shall be paid by the Owner to the Contractor when the work has been completed the Contract fully performed to the satisfaction of the Owner, and a final Certificate for Payment has been issued by the Architect, subject to all other provisions of the Contract relating hereto, including, without limitation, Paragraph 9.9 & 9.10 of the General Conditions of the Contract.

In addition to the above, the Contractor must furnish the following prior to final payment:

- a. Operation & Maintenance Manuals.
- b. As-Built Record Drawings.
- c. All Required Warranties and Guarantees.

ARTICLE 7  
MISCELLANEOUS PROVISIONS

Terms used in this Agreement which are defined in the Conditions of the Contract shall have the meanings designated in those Conditions.

The Contract Documents, which constitute the entire agreement between the Owner and the Contractor, are listed in Article 1 and, except for Modifications issued after execution of the Agreement, are shown on the attached "Table of Contents" and enumerated as follows:

Drawings and Specifications: Dated ***March 28, 2025***

1. **Specifications:** New elementary school; 1200 W. Swedesford road
2. **Drawings:** See Sheet **A001** for list of drawings.
3. **Addenda:** Issued in advance of the Bid.

The Contractor shall comply with the requirements of the "Pennsylvania Prevailing Wage Act" 43 P.S. 165.1 et seq., including, but not limited to, the preparation, retention and submission of records as required by the Act.

The Contractor shall comply with the requirements of the "Pennsylvania Act 34, Act 151 and Act 114 ", requiring background checks for all personnel working on site, including personnel of subcontractors, per Section 26 of the Instructions to Bidders. The Contractor's workmen and subcontractors' workmen shall sign and submit form PDE-6004. The Contractor and Subcontractors shall conform to the requirements of the Public Works Employment Verification Act, per Pennsylvania ACT 127 and the U.S. Department of Homeland Security.

This Agreement entered into as of the day and year first above written.

OWNER:  
Tredyffrin/Easttown  
School District

CONTRACTOR:

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Signature

Arthur J. McDonnell – Business Manager  
Print Name and Title

\_\_\_\_\_  
Print Name and Title

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### **BIDDERS CHECK LIST**

Bidders should check to confirm that the following items are completed and are part of each bid package being submitted to the Tredyffrin/Easttown School District. 4 Copies of each are required – one with original signatures and seals, the other may be exact copies.

Each bid package must contain:

- ☐ Form of Proposal (on PennBid)  
- acknowledge all Addenda received in the appropriate space
- ☐ Bid Bond
- ☐ Non-Collusion Affidavit
- ☐ Contractor's Qualification Statement
- ☐ Read the Instructions to Bidders

# Digital Data Licensing Agreement

AGREEMENT made as of the                      day of                      in the year                       
(In words, indicate day, month and year.)

BETWEEN the Party transmitting Digital Data ("Transmitting Party"):  
(Name, address and contact information, including electronic addresses)  
HSA Version February 14, 2023

HECKENDORN SHILES ARCHITECTS LTD  
347 EAST CONESTOGA ROAD WAYNE,  
PENNSYLVANIA 19087

and the Party receiving the Digital Data ("Receiving Party"):  
(Name, address and contact information, including electronic addresses)

RECEIVING PARTY  
RECEIVING PARTY  
RECEIVING PARTY

for the following Project:  
(Name and location or address)

PROJECT NAME  
PROJECT ADDRESS  
PROJECT ADDRESS

The Transmitting Party and Receiving Party agree as follows.

## TABLE OF ARTICLES

1. GENERAL PROVISIONS
2. TRANSMISSION OF DIGITAL DATA
3. LICENSE CONDITIONS
4. LICENSING FEE OR OTHER COMPENSATION
5. DIGITAL DATA

## ARTICLE 1 GENERAL PROVISIONS

§ 1.1 The purpose of this Agreement is to grant a license from the Transmitting Party to the Receiving Party for the Receiving Party's use of Digital Data on the Project, and to set forth the license terms.

§ 1.2 This Agreement is the entire and integrated agreement between the parties. Except as specifically set forth herein, this Agreement does not create any other contractual relationship between the parties.

§ 1.3 for purposes of this Agreement, the term Digital Data is defined to include only those items identified in Article 5 below.

§ 1.3.1 Confidential Digital Data is defined as Digital Data containing confidential or business proprietary information that the Transmitting Party designates and clearly marks as "confidential."

## ARTICLE 2 TRANSMISSION OF DIGITAL DATA

§ 2.1 The Transmitting Party grants to the Receiving Party a nonexclusive limited license to use the Digital Data identified in Article 5 solely and exclusively to perform services for, or construction of, the Project in accordance with the terms and conditions set forth in this Agreement.

§ 2.2 The transmission of Digital Data constitutes a warranty by the Transmitting Party to the Receiving Party that the Transmitting Party is the copyright owner of the Digital Data, or otherwise has permission to transmit the Digital Data to the Receiving Party for its use on the Project in accordance with the terms and conditions of this Agreement.

§ 2.3 If the Transmitting Party transmits Confidential Digital Data, the transmission of such Confidential Digital Data constitutes a warranty to the Receiving Party that the Transmitting Party is authorized to transmit the Confidential Digital Data. If the Receiving Party receives Confidential Digital Data, the Receiving Party shall keep the Confidential Digital Data strictly confidential and shall not disclose it to any other person or entity except as set forth in Section 2.3.1.

§ 2.3.1 The Receiving Party may disclose the Confidential Digital Data as required by law or court order, including a subpoena or other form of compulsory legal process issued by a court or governmental entity. The Receiving Party may also disclose the Confidential Digital Data to its employees, consultants or contractors in order to perform services or work solely and exclusively for the Project, provided those employees, consultants and contractors are subject to the restrictions on the disclosure and use of Confidential Digital Data as set forth in this Agreement.

§ 2.4 The Transmitting Party retains its rights in the Digital Data. By transmitting the Digital Data, the Transmitting Party does not grant to the Receiving Party an assignment of those rights; nor does the Transmitting Party convey to the Receiving Party any right in the software used to generate the Digital Data.

§ 2.5 To the fullest extent permitted by law, the Receiving Party shall indemnify and defend the Transmitting Party from and against all claims arising from or related to the Receiving Party's use or modification of, the Digital Data.

§ 2.6 The Receiving Party acknowledges that Digital Data is being provided as a convenience for project coordination. It is the responsibility of the Receiving Party to confirm (as a field verification where applicable) all conditions, dimensions, relationships contained or documented in the Digital Data. The Transmitting Party makes no representation as the accuracy, completeness, or permeance, nor for the merchantability or fitness for a particular purpose, of Digital Data. In the event of any conflict between the Digital Data or the Contract Documents, Contract Documents shall govern. The Receiving Party is responsible for determine if any conflicts exist.

§ 2.7 The Receiving Party shall execute this agreement with any other party wishing to obtain the Digital Data, after prior written approval to do so from the Transmitting Party.

§ 2.8 Specifically in regard to transfer of Building Information Model files (BIM); The Receiving Party is

reminded that that BIM, transferred in electronic files, can be modified, intentionally or unintentionally, by others. Note that BIM does not constitute construction documents and differences may exist between the BIM and the corresponding hard-copy documents. The Transmitting Party makes no representation about the accuracy or completeness of the BIM being transferred. The final, hard copy, signed and sealed construction documents shall govern, as differences in the versions may exist, creating inaccuracies in the BIM.

The Receiving Party, in consideration for transfer of BIM, agrees to indemnify and hold harmless the Transmitting Party against all damages, liabilities or costs, including reasonable attorneys' fees and defense costs, arising out of or resulting from the Receiving Party or the reuse of the BIM files by another party.

Any unauthorized use or reuse by the Receiving Party or by others will be at the Receiving Party's sole risk and without liability or legal exposure to the Transmitting Party. The Receiving Party agrees to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against the Transmitting Party, our officers, directors, employees, agents or subconsultants that may arise out of or in connection with your use of the BIM files.

#### ARTICLE 3 LICENSE CONDITIONS

The parties agree to the following conditions on the limited license granted in Section 2.1:  
(State below rights or restrictions applicable to the Receiving Party's use of the Digital Data, requirements for data format, transmission method or other conditions on data to be transmitted)

#### ARTICLE 4 LICENSING FEE OR OTHER COMPENSATION

The Receiving Party agrees to pay the Transmitting Party the following fee or other compensation for the Receiving Party's use of the Digital Data:

Zero Dollars, Zero Cents (\$0.00)

(State the fee, in dollars, or other method by which the Receiving Party will compensate the Transmitting Party for the Receiving Party's use of the Digital Data.)

#### ARTICLE 5 DIGIAL DATA

DATA DESCRIPTION

DATA NAMES

DATA NAMES

**TRANSMITTING PARTY:** (Signature)

**RECEIVING PARTY:** (Signature)

(Signature)

(Signature)

(Printed name and title)

(Printed name and title)

(Date)

(Date)

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## SECTION 01041 – PROJECT COORDINATION MULTIPLE PRIME CONTRACTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and the general provisions of the Contract, including General and Supplementary Conditions, General Requirements and Division 1 Specification Sections, apply to the work specified in this Section.

#### 1.2 SUMMARY

- A. This Section specified minimum administrative and supervisory requirements necessary for coordination on the Project to be collectively fulfilled by the prime Contractors including, but not limited to:
  - 1. Coordination
  - 2. Administrative and supervisory personnel.
  - 3. General installation provisions.
  - 4. Cleaning and protection.
- B. Where applicable, each prime Contractor shall participate in these coordination requirements, even though certain areas of responsibility are assigned to a specific prime Contractor, and even though the Contractor for General Construction is assigned general responsibility for overall coordination purposes.
- C. Progress meetings, coordination meetings and pre-installation conferences are covered in the job information sheet, which will be distributed to the contractors at the start of the project.
- D. Requirement for the Contractor's Construction Schedule is included in the General Requirements, Section 7 "Construction Schedule".

#### 1.3 COORDINATION

- A. Coordination: Each prime Contractor shall coordinate its construction activities with those of other prime Contractors and other entities involved to assure efficient and orderly installation of each part of the work. Each prime Contractor shall coordinate its operations with operations included under different Sections of the Specifications that are dependent upon each other for proper installation, connection, and operation.
  - 1. Where installation of one part of the work is dependent on installation of other components, either before or after its own installation, each prime Contractor shall schedule its construction activities in the sequence required to obtain the best results. This will require discussions between job superintendents to formulate an approach. This approach will be discussed with the Architect ahead of installation.
  - 2. Where availability of space is limited, each prime Contractor shall coordinate installation of different components with other prime Contractors to assure maximum accessibility for required maintenance, service and repair.
  - 3. Each prime Contractor shall make adequate provisions to accommodate items scheduled for later installation.



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4. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include items such as required notices, reports, and attendance at meetings.
  - a. Prepare similar memoranda for the Owner and separate Contractors where coordination of their work is required.
  - b. If the construction or installation of work or a product affects the work of another contractor, the contractors must coordinate their shop drawings to include the other contractor's work.
  - c. Contractors must provide copies of their shop drawings to other prime contractors when their work interfaces with the other prime contractors.
- B. Administrative Procedure: Each prime Contractor shall coordinate scheduling and timing of its administrative procedures with other construction activities and activities of other prime Contractors to avoid conflicts and ensure orderly progress of the work. Such administrative activities include, but are not limited to:
  1. Preparation of schedules.
  2. Installation and removal of temporary facilities.
  3. Delivery and processing of submittals.
  4. Progress meetings.
  5. Project Closeout activities.
- C. Scheduling inspections and tests is the responsibility of the coordinator of each prime. Special Inspections/Testing shall be furnished by the Owner, unless specifically noted otherwise, but the Contractor will be responsible to schedule such test (or inspection) and to notify the Owner in advance.
- D. Conservation: Each prime Contractor shall coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1.4 SUBMITTALS (see also Section 01330 of these specifications)

- A. Coordination Drawings: Prepare and submit Coordination Drawings where close and careful coordination is required for installation of products and materials fabricated off-site by separate entities, and where limited space availability necessitates maximum utilization of space for efficient installation of different components.
  1. Show the inter-relationship of components shown on separate shop drawings.
  2. Indicate required installation sequences.
  3. Comply with requirements contained in Section "Submittals" of respective technical specification sections.
  4. Refer to Division 23 and 26 for specific Coordination Drawing requirements for mechanical and electrical installation.
  5. Refer to all drawings in the Contract Documents for coordination with other trades.
- B. Preparation Responsibility: Preparation of Coordination Drawings is the responsibility of the prime Contractor principally involved, where involvement by other prime Contractors is minor.
  1. Where there is substantial participation by more than one prime Contractor, including the Contractor for Mechanical Construction, the Contractor for Mechanical Construction shall prepare the coordination drawings.
  2. Where there is substantial participation by more than one prime contractor, but the Contractor for Mechanical Construction is not involved, the Architect shall designate the prime Contractor with the most involvement as responsible for preparation of Coordination drawings.

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- C. Staff Names: Within 15 days of Notice to Proceed, each prime contractor shall submit a list of its principal staff assignments, including the Superintendent and other personnel in attendance at the site at all times:
1. Post copies of the list in the project meeting room, the temporary field office, and at each temporary telephone and addresses. If no such office is to be present, submit the list to the Architect and Owner, for incorporation into a Project Directory, which shall be furnished by the Architect.

1.5 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

- A. Project Coordinator: The contractor for the General Construction shall provide a full-time Project Coordinator, experienced in administration and supervision of building construction, including mechanical, electrical, plumbing and general construction work. This shall be the on-site superintendent / foreman. The Project Coordinator shall be authorized to act as the coordinator of construction activities between the separate prime Contracts.
1. Construction activities requiring coordination by the Project coordinator include but are not limited to:
    - a. Scheduling and sequencing the work.
    - b. Sharing access to work spaces.
    - c. Installations.
    - d. Protection of each other's work.
    - e. Cutting and patching.
    - f. Preparation of Coordination Drawings.
    - g. Scheduling inspections and tests is the responsibility of the coordinator of each prime. Testing shall be furnished by the Owner, unless specifically noted otherwise, but the Contractor will be responsible to schedule such test (or inspection) and to notify the Owner in advance.
    - h. Temporary services and facilities are the responsibility of each prime.
    - i. Attendance at all construction meetings.
    - j. Coordinate all access, deliveries, laydown and stockpile areas, equipment locations and sequencing of work.
- B. Mechanical/ Plumbing/ Electrical Coordinators: The Heating, Ventilating, and Air Conditioning (HVAC) Contractor, the Plumbing contractor, and the Electrical contractor shall each provide a full-time mechanical /plumbing/ electrical coordinator, experienced in administrative and supervisory coordination of mechanical, plumbing and electrical construction. This shall be the on-site superintendent / foreman. This experience shall include coordination of the type of operations required for this Project, and coordination of mechanical/electrical construction with other types of operations.
1. The Mechanical/Plumbing/Electrical Coordinators shall be required to act as the specialized coordinator of construction activities within mechanical and electrical operations, and between those activities and activities of other separate prime contracts.
  2. Construction activities requiring coordination by the Mechanical/Plumbing/Electrical Coordinator include but are not limited to:
    - a. Scheduling and sequencing of mechanical and electrical activities.
    - b. Sharing access to work spaces.
    - c. Integration of mechanical and electrical into limited spaces available for mechanical and electrical installations.
    - d. Protection of each prime Contractor's work.
    - e. Cutting and patching.
    - f. Tolerances.
    - g. Preparation of mechanical, plumbing, and electrical coordination drawings.
    - h. Inspections and tests.

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- i. Utilization of mechanical and electrical temporary services and facilities.
- j. Attendance at all construction meetings

- C. General Contractor, Mechanical, Plumbing and Electrical Contractors must coordinate their respective work with one another. All Prime contractors must have one project supervisor who is assigned from the "office" to coordinate the work in the field and with the subcontractors. This person cannot be a contractor involved with the physical construction of the building. This person must attend each job meeting and be familiar with the work.

1.6 GENERAL CONSTRUCTION CONTRACT

- A. The General Construction Contractor shall provide all labor, material, tools, equipment, and supervision necessary to complete the work of this bid package. This work includes but is not limited to, the following:
- 1. Scope of work identified on Architectural Drawings
  - 2. Scope of work as identified on Structural Drawings
  - 3. Scope of work identified on Site Civil Drawings
  - 4. Scope of work identified in Specifications
  - 5. Coordinate all necessary wall blocking with other primes. GC is responsible to install necessary blocking.
  - 6. Installation of access panels provided by other Prime Contractors
  - 7. This contractor will comply with all OSHA requirements pertaining to the performance of his work
    - a. The Prime contractor is responsible to submit a Project Specific Safety Manual that describes hazards associated with their scope of work and mitigation strategies for each hazard. PSSP shall be submitted 5 days prior to starting construction. Prime contractors are responsible to provide a PSSP that covers any task that will be performed by sub tier contractors. PSSP's shall include certifications, training and other special documentation that relates to their scope of work.
  - 8. This contractor is responsible for the immediate clean-up of all mud on the adjacent roads which is a result of this contractor's operations.
  - 9. This contractor will cut and remove all floor slabs for other prime contractors under slab utility work. EC and PC will be responsible for all excavation once slab is removed. Coordinate and cooperate with all prime contractors regarding the under slab utility work; this shall include all sleeves and openings. This contractor will install all slab infill at completion of under slab utility work.
  - 10. Provide all weather protection necessary to accomplish the work in accordance with the schedule requirements. This shall include but not limited to dewatering of excavations, winter protection and temporary heat and frost protection of subgrade as required.
  - 11. Provide and maintain temporary fire extinguishers throughout construction as required.
  - 12. Provide snow and ice removal at all temporary parking, temporary access, service roads, and trailer complex as required during the duration of the project.
  - 13. GC prime is responsible to hire a 3rd party utility locator in addition to a PA One call; Site utility survey shall be performed prior to mobilization. Any conflicts shall be reported to the Architect/Engineer immediately.
  - 14. Project identification and temporary signs.
  - 15. Pest control.
  - 16. Barricades, warning signs, and lights.
  - 17. Temporary enclosure for building exterior.
  - 18. Partial Testing of systems may be required so that other contractors can complete their work in a timely manner. These tests will be performed at no additional cost to the owner. Any additional valving and capping of lines required for this testing will be this

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- contractor's responsibility.
19. Provide and install all sealants, firestop and caulking at all penetrations required in the performance of this Work and as specified in the Contract Documents. The integrity of fire, smoke and sound walls must be maintained. Sealants required at interface points between materials supplied by others and materials supplied by this Bid Package will be this Contractor's responsibility.

1.7 MECHANICAL CONSTRUCTION CONTRACT

- A. The Mechanical Contractor shall provide all labor, material, tools, equipment, and supervision necessary to complete the work of this bid package. This work includes but is not limited to, the following:
1. Scope of work identified on Mechanical Drawings
  2. Scope of work identified in Specifications
  3. Refer to Specification Section 230000 for additional information.
  4. This Contractor is responsible for all survey engineering and layout required for work of this bid package from control lines established by the GC.
  5. Partial testing of systems may be required so that other Contractors can complete their work in a timely manner. These tests will be performed as directed by the Construction Manager at no additional cost to the Owner. Any additional valving and capping of lines required for this testing will be this Contractor's responsibility.
  6. This contractor will comply with all OSHA requirements pertaining to the performance of his work
    - a. The Prime contractor is responsible to submit a Project Specific Safety Manual that describes hazards associated with their scope of work and mitigation strategies for each hazard. PSSP shall be submitted 5 days prior to starting construction. Prime contractors are responsible to provide a PSSP that covers any task that will be performed by sub tier contractors. PSSP's shall include certifications, training and other special documentation that relates to their scope of work.
  7. Provide and install all sealants, firestop and caulking at all penetrations required in the performance of this Work and as specified in the Contract Documents. The integrity of fire, smoke and sound walls must be maintained. Sealants required at interface points between materials supplied by others and materials supplied by this Bid Package will be this Contractor's responsibility.
  8. Coordination with all Primes, Owner and Architect required.

1.8 PLUMBING CONSTRUCTION CONTRACT

- A. The Plumbing Contractor shall provide all labor, material, tools, equipment, and supervision necessary to complete the work of this bid package. This work includes but is not limited to, the following:
1. Scope of work identified on Plumbing Drawing
  2. Scope of work identified on Fire Protection Drawings
  3. Scope of work identified in Specifications
  4. Refer to Specification Sections 210000 and 220000 for additional information
  5. This Contractor is responsible for all survey engineering and layout required for work of this bid package from control lines established by the GC.
  6. Partial testing of systems may be required so that other Contractors can complete their work in a timely manner. These tests will be performed as directed by the Construction Manager at no additional cost to the Owner. Any additional valving and capping of lines required for this testing will be this Contractor's responsibility.
  7. This contractor will comply with all OSHA requirements pertaining to the performance of his work
    - a. The Prime contractor is responsible to submit a Project Specific Safety Manual

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that describes hazards associated with their scope of work and mitigation strategies for each hazard. PSSP shall be submitted 5 days prior to starting construction. Prime contractors are responsible to provide a PSSP that covers any task that will be performed by sub tier contractors. PSSP's shall include certifications, training and other special documentation that relates to their scope of work.

8. Provide and install all sealants, firestop and caulking at all penetrations required in the performance of this Work and as specified in the Contract Documents. The integrity of fire, smoke and sound walls must be maintained. Sealants required at interface points between materials supplied by others and materials supplied by this Bid Package will be this Contractor's responsibility.
9. The GC will cut and remove all floor slabs for other prime contractors' under-slab utility work. This contractor will be responsible for excavation required for plumbing infrastructure installation once slab is removed. Coordinate and cooperate with all prime contractors regarding the under-slab utility work; this shall include all sleeves and openings.
10. Coordination with all Primes, Owner and Architect required.
11. Provide, maintain, and remove when directed all necessary Temporary Water as specified in the Contract Documents. This Contractor is responsible to coordinate this work and to provide all engineering, equipment, enclosures, pads, barricades and supports as required to provide these temporary services.

#### 1.9 ELECTRICAL CONSTRUCTION CONTRACT

- A. The Electrical Contractor shall provide all labor, material, tools, equipment, and supervision necessary to complete the work of this bid package. This work includes but is not limited to, the following:
  1. Scope of work identified on Electrical Drawings
  2. Scope of work identified in Specifications
  3. Refer to Specification Section 260000 for additional information.
  4. This Contractor is responsible for all survey engineering and layout required for work of this bid package from control lines established by the GC.
  5. Partial testing of systems may be required so that other Contractors can complete their work in a timely manner. These tests will be performed as directed by the Construction Manager at no additional cost to the Owner. Any additional valving and capping of lines required for this testing will be this Contractor's responsibility.
  6. This contractor will comply with all OSHA requirements pertaining to the performance of his work
    - a. The Prime contractor is responsible to submit a Project Specific Safety Manual that describes hazards associated with their scope of work and mitigation strategies for each hazard. PSSP shall be submitted 5 days prior to starting construction. Prime contractors are responsible to provide a PSSP that covers any task that will be performed by sub tier contractors. PSSP's shall include certifications, training and other special documentation that relates to their scope of work.
  7. Provide and install all sealants, firestop and caulking at all penetrations required in the performance of this Work and as specified in the Contract Documents. The integrity of fire, smoke and sound walls must be maintained. Sealants required at interface points between materials supplied by others and materials supplied by this Bid Package will be this Contractor's responsibility.
  8. The GC will cut and remove all floor slabs for other prime contractors' under-slab utility work. This contractor will be responsible for excavation required for electrical infrastructure installation once slab is removed. Coordinate and cooperate with all prime

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contractors regarding the under-slab utility work; this shall include all sleeves and openings.

9. Coordination with all Primes, Owner and Architect required.
10. Provide, maintain, and remove when directed all necessary Temporary Power and Lighting as specified in the Contract Documents. This Contractor is responsible to coordinate this work and to provide all engineering, equipment, enclosures, pads, barricades and supports as required to provide these temporary services.

#### 1.10 TEMPORARY FACILITIES

- A. Temporary Facilities and Controls : In addition to specific responsibilities for temporary facilities and controls indicated in other sections, Each Prime Contractor is responsible for the following:
1. 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.
  2. Plug-in electric power cords and extension cords, 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 telephone service.
  4. Its own storage and fabrication sheds.
  5. Temporary enclosures for its own construction activities.
  6. Staging and scaffolding for its own construction activities.
  7. General hoisting facilities for its own construction activities.
  8. Waste disposal facilities, including collection and legal disposal of its own hazardous, dangerous, unsanitary, or other harmful waste materials.
  9. Progress cleaning of work areas affected by its operations on a daily basis.
  10. Secure lockup of its own tools, materials, and equipment.
  11. Construction aids and miscellaneous services and facilities necessary exclusively for its own construction activities.
  12. Each Prime Contractor is responsible for temporary heating, cooling, and ventilation as needed for their scope before weathertight enclosure of building is complete. Usage charges are responsibility of each prime.

#### PART 2 - PRODUCTS (Not Applicable)

#### PART 3 - EXECUTION

##### 3.1 GENERAL INSTALLATION PROVISIONS

- A. Inspection of Conditions: The prime Contractor involved shall require the installer of each major component to inspect both the substrate and conditions under which work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.
- B. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.
1. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.
  2. Provide attachment and connection devices and methods necessary for securing work. Secure work true to line and level. Allow for expansion and building movement.

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- C. Visual Effects: Provide uniform joint widths in exposed work. Arrange joints in exposed work to obtain the best visual effect. Refer questionable choices to the Architect for final decision.
- D. Recheck measurements and dimensions, before starting each installation.
- E. Install each component during weather conditions and project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.
- F. Enclosure of the work: Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.
- G. Mount Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Architect for final decision. Comply with all applicable codes and authorities having jurisdiction.
- H. All contractors are to keep careful scaled and dimensioned drawings of as-built conditions.

### 3.2 CLEANING AND PROTECTION

- A. Each Prime Contractor shall be responsible for securing and paying for dumpsters and trash bins as required for disposal of demolition and construction debris during the project for their respective trade. However, the Contractors are encouraged to work together to limit the quantity of dumpsters required on site at any given time.
- B. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure freedom from damage or deterioration at Substantial Completion.
- C. Clean and maintain completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- D. Limiting Exposures: Each prime contractor shall supervise its construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to the following:
  - 1. Excessive static or dynamic loading.
  - 2. Excessive internal or external pressures.
  - 3. Excessively high or low temperatures.
  - 4. Thermal shock.
  - 5. Excessively high or low humidity.
  - 6. Air contamination or pollution.
  - 7. Water or ice.
  - 8. Solvents.
  - 9. Chemicals.
  - 10. Light.
  - 11. Radiation.
  - 12. Puncture.
  - 13. Abrasion.
  - 14. Heavy traffic.
  - 15. Soiling, staining and corrosion.

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16. Bacteria.
17. Rodent and insect infestation.
18. Combustion.
19. Electrical current.
20. High speed operation.
21. Improper installation, shoring, or bracing.
22. Unusual wear or other misuse.
23. Contact between incompatible materials.
24. Destructive testing.
25. Misalignment.
26. Excessive weathering.
27. Unprotected storage.
28. Improper shipping or handling.
29. Theft.
30. Vandalism.
31. Trash storage and pickup.
32. Telecommunications.

**END OF SECTION**



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SECTION 011200 – SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. For a complete list of definitions for this contract refer to the Division 1 specifications.
- B. Provide: Means to provide, install and make the equipment/system completely functional and operational with testing, and training.
- C. Install: Means to provide, install and make the equipment/system completely functional and operational with testing, and training.
- D. NES –New Elementary School.
- E. Contractor Definitions;
  - 1. General Contractor (GC): General Contractor responsible for performing all public bid work on the building, and site, excluding the items defined as owner's vendor other prime contractor responsibilities.
  - 2. Mechanical Contractor (MC): Mechanical Contractor responsible for performing all public bid mechanical work on the building, excluding the items defined as owner's vendor other prime contractor responsibilities.
  - 3. Electrical Contractor (EC): Electrical Contractor responsible for performing all public bid electrical work on the building and site, excluding the items defined as owner's vendor other prime contractor responsibilities.
  - 4. Plumbing Contractor (PC): Plumbing Contractor responsible for performing all public bid plumbing and fire protection work on the building, excluding the items defined as owner's vendor other prime contractor responsibilities.
  - 5. Playground Equipment Vendor (PEV): Owner's vendor hired through Cooperative Purchasing Program responsible for providing and installing all playground Surfaces, and Playground Equipment.
  - 6. Solar (photovoltaic) Panel Vendor (SPV): Owner's vendor hired through Cooperative Purchasing Program responsible for providing and installing Solar Panel Equipment. Refer to electrical drawings for detailed description.

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7. Athletic Equipment Vendor (AEV): Owner's vendor hired through Cooperative Purchasing Program responsible for providing and installing all interior and exterior athletic equipment.
8. IT Telecom Vendor (ITV): Owner's vendor hired through Cooperative Purchasing Program responsible for providing and installing all IT Telecom equipment.
9. Audio Visual Vendor (AVV): Owner's vendor hired through Cooperative Purchasing Program responsible for providing and installing all Audio Visual equipment.
10. Security/Intrusion Vendor (SV): Owner's vendor hired through Cooperative Purchasing Program responsible for providing and installing security/intrusion equipment as noted.
11. Security Camera Vendor (SCV): Owner's vendor hired through Cooperative Purchasing Program responsible for providing and installing security camera equipment as noted.
12. Access Control Vendor (ACV): Owner's vendor hired through Cooperative Purchasing Program responsible for providing and installing access control equipment as noted.
13. Furniture Vendor (FV): Owner's vendor hired through Cooperative Purchasing Program responsible for providing and installing all Furniture.
14. Outside Plant (OSP) contractor: Owner's contractor under separate contract responsible for providing and installing the wide area fiber-optic network offsite and terminated at the building MDF Room.

1.3 SCOPE OF WORK

- A. Work Included: It is the intent of these specifications and the accompanying drawings that the Contractor shall, unless otherwise specified herein, furnish all labor, materials, tools, and equipment necessary, together with the necessary accessories to constitute a satisfactory and complete installation of the work, as indicated on the drawings and described hereinafter. The Contractor shall properly install, equip, adjust and put in perfect condition, the respective portions of the work specified, and to so interconnect the various items or sections of the work to form a complete and properly operating whole. The work shall consist of but shall not necessarily be limited to the following for the New Elementary School at 1200 W. Swedesford Road in the Tredyffrin/Easttown School District.
- B. It will be the responsibility of the Contractor to examine all Drawings to determine the full extent of the work. All field measurements and verifications of conditions and materials will be the obligation of the Contractor. The submission of a Proposal by the Contractor will be considered an indication that all work has been included in the Proposal. It will also be considered an indication that a thorough review of conditions, materials, and all related specifications have been investigated by the Contractor, and the results of such investigations have been included in the Contractor's Proposal.

**END OF SECTION**

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SECTION 012200 - UNIT PRICES

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. This Section includes administrative and procedural requirements for unit prices.
- B. Related Sections include the following:
  - 1. Division 01 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.3 DEFINITIONS

- A. Unit price is an amount proposed by bidders, stated on the Bid Form, 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. Unit prices and quantity allowances shall be utilized for required changes in the work during construction as authorized by the Architect and Owner. Unit prices and quantity allowances shall not be utilized for the quantities of work shown in the bid documents.

1.4 PROCEDURES

- A. Unit prices shall 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: A list of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.
- E. For the quantity allowances required to be included in the bid, they must be included in each Prime Contractor's base bid. The schedule of values for each Prime Contractor on the project shall include a combined line item that reflects the total of the quantity allowances included in the base bid. The architect will maintain a spreadsheet of the value of the total quantity allowance and any approved additional work

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to be billed against the quantity allowance. The contractor will be required to submit change orders against the quantity allowance line item; no unauthorized work will be allowed to be billed against the line item. Any unused money remaining on the quantity allowance line item shall be returned to the Owner at the end of the project via a credit change order.

1.5 UNIT PRICE QUANTITY ALLOWANCES

- A. The Quantity Allowances noted below are above and beyond the required scope and quantities documented in the drawings and specifications but are to be included in the base bid.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 LIST OF UNIT PRICES

A. G Unit Prices

1. Unit Price No. G1 – Acoustic Ceiling Tiles
  - a. Description: Installation of ACT-1 tiles and grid
  - b. Unit of Measurement: 100 SF
  - c. Quantity allowance to include in bid: 1,000 SF
2. Unit Price No. G2 – Ceiling Paint
  - a. Description: Include GWB preparation, priming and finish coat of P-6
  - b. Unit of Measurement: 100 SF
  - c. Quantity allowance to include in bid: 4,000 SF
3. Unit Price No. G3 – Wall Paint
  - a. Description: Include wall preparation, priming and finish coat of P-1
  - b. Unit of Measurement: 100 SF
  - c. Quantity allowance to include in bid: 4,000 SF
4. Unit Price No. G4 – VCT
  - a. Description: Include floor preparation and installation of VCT-1, VCT-2, VCT-3 classroom mix percentages per finish schedule.
  - b. Unit of Measurement: 100 SF
  - c. Quantity allowance to include in bid: 1,000 SF
5. Unit Price No. G5 – Terrazzo-Field
  - a. Description: Include floor preparation and installation of TZ-1.
  - b. Unit of Measurement: 100 SF
  - c. Quantity allowance to include in bid: 1,000 SF
6. Unit Price No. G6 – Terrazzo-Accent
  - a. Description: Include floor preparation and installation of TZ-2,3,4 or 5.
  - b. Unit of Measurement: 100 SF
  - c. Quantity allowance to include in bid: 500 SF

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7. Unit Price No. G7 – Tile-1
  - a. Description: Include wall preparation and installation of T-1.
  - b. Unit of Measurement: 100 SF
  - c. Quantity allowance to include in bid: 1,000 SF
8. Unit Price No. G8 – Tile-2
  - a. Description: Include wall preparation and installation of T-2.
  - b. Unit of Measurement: 100 SF
  - c. Quantity allowance to include in bid: 500 SF
9. Unit Price No. G9 – Tile-Accent
  - a. Description: Include wall preparation and installation of T-3,4,5,6,7, or 8.
  - b. Unit of Measurement: 10 SF
  - c. Quantity allowance to include in bid: 200 SF
10. Unit Price No. G10 – Wall Base
  - a. Description: Include installation of wall base, B-1.
  - b. Unit of Measurement: 10 LF
  - c. Quantity allowance to include in bid: 500 LF
11. Unit Price No. G11 – Epoxy Floor-1
  - a. Description: Include floor preparation and installation of EP-1.
  - b. Unit of Measurement: 10 SF
  - c. Quantity allowance to include in bid: 50 SF
12. Unit Price No. G12 – Insulated Glazing Unit
  - a. Description: Include preparation and installation of GLS-1 with new exterior storefront framing.
  - b. Unit of Measurement: 10 SF
  - c. Quantity allowance to include in bid: 50 SF
13. Unit Price No. G13 – Insulated Glazing Unit
  - a. Description: Include preparation and installation of GLS-5 in existing window framing.
  - b. Unit of Measurement: 10 SF
  - c. Quantity allowance to include in bid: 200 SF
14. Unit Price No. G14 – GWB Partition
  - a. Description: Include installation of partition type A3DS.
  - b. Unit of Measurement: 10 LF
  - c. Quantity allowance to include in bid: 500 LF
15. Unit Price No. G15 – Existing Slab Trenching/Removal
  - a. Description: Include removal of existing concrete slab and subgrade to a depth of 2'-0".
  - b. Unit of Measurement: 10 Cubic Feet
  - c. Quantity allowance to include in bid: 1,000 Cubic Feet
16. Unit Price No. G16 – Existing Deteriorated Metal Stud and insulation Removal/Replacement
  - a. Description: Include removal of existing deteriorated metal studs, bottom track, top track and insulation at perimeter low wall partition, and replacement with new metal studs, bottom track, top track, and SAFB.
  - b. Unit of Measurement: 10 LF
  - c. Quantity allowance to include in bid: 500 LF

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17. Unit Price No. G17 – Existing Wet Roof Insulation Removal/Replacement
  - a. Description: Include removal of existing wet roof insulation, and replacement with new insulation.
  - b. Unit of Measurement: 10 SF
  - c. Quantity allowance to include in bid: 1,000 SF
18. Unit Price No. G18 – Existing Deteriorated Metal Roof Deck Removal/Replacement
  - a. Description: Include removal of existing deteriorated metal roof deck, and replacement with new metal roof deck to match existing type and size.
  - b. Unit of Measurement: 10 SF
  - c. Quantity allowance to include in bid: 500 SF
19. Unit Price No. G19 – Brick Masonry-1
  - a. Description: Include installation of exterior modular brick masonry.
  - b. Unit of Measurement: 50 SF
  - c. Quantity allowance to include in bid: 500 SF
20. Unit Price No. G20 – Brick Masonry-2
  - a. Description: Include installation of exterior thin brick veneer masonry system.
  - b. Unit of Measurement: 50 SF
  - c. Quantity allowance to include in bid: 100 SF
21. Unit Price No. G21 –Roof-1
  - a. Description: Include the preparation of installation of re-roof 20 yr. EPDM roof type.
  - b. Unit of Measurement: 100 SF
  - c. Quantity allowance to include in bid: 500 SF
22. Unit Price No. G22 –Roof-2
  - a. Description: Include the preparation of installation of 30 yr. EPDM roof type.
  - b. Unit of Measurement: 100 SF
  - c. Quantity allowance to include in bid: 500 SF
23. Unit Price No. G23 – Rock Removal
  - a. Description: Rock Excavation
  - b. Unit of Measurement: 100 Cubic Yard
24. Unit Price No. G24 – Earth Excavation
  - a. Description: Earth Excavation, vertical faced, pit and trench
  - b. Unit of Measurement: Cubic Yard
25. Unit Price No. G25 – Reclamation Fill
  - a. Description: Removal and disposal of Reclamation Fill, including excavation, hauling and dumping fees.
  - b. Unit of Measurement: Cubic Yard

B. E Unit Prices

1. Unit Price No. E1 – ¾" Conduit and Cabling:
  - a. Description: ¾" EMT conduit with supports and couplings and 3#12+1#12GND wiring according to Division 26 Sections "Low-Voltage Electrical Power Conductors and Cables," "Raceways and Boxes for Electrical Systems" and "Hangers and Supports for Electrical Systems."
  - b. Unit of Measurement: Linear Feet (LF).

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- c. Quantity allowance to include in bid: 2,000 LF.
- 2. Unit Price No. E2 – MC #12 Luminary Cabling:
  - a. Description: Type MC 2#12+1#12GND with 2#16AWG Luminary Cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
  - b. Unit of Measurement: Linear Feet (LF).
  - c. Quantity allowance to include in bid: 2,000 LF.
- 3. Unit Price No. E3 – MC #10 Cabling:
  - a. Description: Type MC Galvanized cabling 3#10+1#10GND according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
  - b. Unit of Measurement: Linear Feet (LF).
  - c. Quantity allowance to include in bid: 2,000 LF.
- 4. Unit Price No. E4 – 20A Receptacle and Wiring:
  - a. Description: 20A industrial/heavy duty grade NEMA 5-20R receptacle, backbox, faceplate and 125 LF of  $\frac{3}{4}$ " conduit and 2#12+1#12GND wiring according to Division 26 Sections "Low-Voltage Electrical Power Conductors and Cables," "Raceways and Boxes for Electrical Systems" and "Hangers and Supports for Electrical Systems," and "Wiring Devices."
  - b. Unit of Measurement: Each (EA).
  - c. Quantity allowance to include in bid: 50.
- 5. Unit Price No. E5 – 20A Toggle Switch:
  - a. Description: 20A industrial/heavy duty grade toggle switch (single pole, 3-way or 4-way as required), backbox, faceplate and 50 LF of  $\frac{3}{4}$ " conduit and 3#12+1#12GND wiring according to Division 26 Sections "Low-Voltage Electrical Power Conductors and Cables," "Raceways and Boxes for Electrical Systems" and "Hangers and Supports for Electrical Systems," and "Wiring Devices."
  - b. Unit of Measurement: Each (EA).
  - c. Quantity allowance to include in bid: 10.
- 6. Unit Price No. E6 – Lighting Fixture Type "A1":
  - a. Description: (1) Fixture type "A1" installed along with 25 LF of MC #12 Luminary Cabling according to Division 26 Sections "Low-Voltage Electrical Power Conductors and Cables" and "Interior Lighting."
  - b. Unit of Measurement: Each (EA).
  - c. Quantity allowance to include in bid: 25.
- 7. Unit Price No. E7 – Digital Lighting Control C01
  - a. Description: (1) Complete digital lighting control type C01 setup in accordance with contract drawing E105 and Division 26 Section "Lighting Controls."
  - b. Unit of Measurement: Each (EA).
  - c. Quantity allowance to include in bid: 5.
- 8. Unit Price No. E8 – Lighting Fixture Type "E1":
  - a. Description: (1) Fixture type "E1" installed along with 100 LF of MC #12 Cabling according to Division 26 Sections "Low-Voltage Electrical Power Conductors and Cables" and "Interior Lighting."
  - b. Unit of Measurement: Each (EA).
  - c. Quantity allowance to include in bid: 5.
- 9. Unit Price No. E9 – (1) Smoke Detector

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- a. Description: (1) Smoke detector, mounted in ceiling, with 100 LF of type MC FPLP twisted, shielded pair cabling, including testing & programming, according to Division 28 Section "Digital, Addressable Fire Alarm System."
  - b. Unit of Measurement: Each (EA).
  - c. Quantity allowance to include in bid: 5.
10. Unit Price No. E10 – (1) Speaker/Strobe
- a. Description: (1) Speaker/strobe device, mounted in ceiling or on wall in backbox, with 100 LF of type MC FPLP cabling, including testing & programming, according to Division 28 Section "Digital, Addressable Fire Alarm System."
  - b. Unit of Measurement: Each (EA).
  - c. Quantity allowance to include in bid: 10.

C. M Unit Prices

1. Unit Price M1: Galvanized Ductwork:
- a. Description: Furnish and install 22 gauge galvanized duct including internal lining, hangers, in accordance with the applicable Division 23 Sections.
  - b. Unit of Measurement: Pounds (lbs).
  - c. Quantity allowance to include in bid: 3,000 lbs.
2. Unit Price M2: Exterior Duct Insulation Wrap:
- a. Description: Furnish and install 1-1/2" Duct Insulation Wrap in accordance with the applicable Division 23 Sections.
  - b. Unit of Measurement: Square Foot.
  - c. Quantity allowance to include in bid: 3,000 SF.
3. Unit Price M3: 1" Copper Pipe Type L
- a. Description: Furnish and install 1-inch L copper HVAC condensate piping and hangers including 1-1/2" ASJ insulation in accordance with the applicable Division 23 Sections.
  - b. Unit of Measurement: Per lineal foot.
  - c. Quantity allowance to include in bid: 500 LF.
4. Unit Price M4: 1-1/4" Copper Pipe Type L
- a. Description: Furnish and install 1-1/4-inch L copper HVAC condensate piping and hangers including 1-1/2" ASJ insulation in accordance with the applicable Division 23 Sections.
  - b. Unit of Measurement: Per lineal foot.
  - c. Quantity allowance to include in bid: 500 LF.
5. Unit Price M5: Controls
- a. Description: Furnish and install sensors (temperature, humidity, pressure, etc.) and connect to DDC system with conduit and wiring for monitoring and control in accordance with applicable Division 23 Sections.
  - b. Unit of Measurement: Per Unit.
  - c. Quantity allowance to include in bid: 20.

D. P Unit Prices

1. Unit Price P1: 3/4" Ball Valve:
- a. Description: Furnish and install 3/4-inch ball valve in Plumbing water piping in accordance with the applicable Division 22 Sections.



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- b. Unit of Measurement: Per assembly.
  - c. Quantity allowance to include in bid: 40.
- 2. Unit Price P2: 1" Ball Valve:
  - a. Description: Furnish and install 1-inch ball valve in Plumbing water piping in accordance with the applicable Division 22 Sections.
  - b. Unit of Measurement: Per assembly.
  - c. Quantity allowance to include in bid: 30.
- 3. Unit Price P3: 3/4" Copper Pipe Type L
  - a. Description: Furnish and install 3/4-inch L copper domestic water piping and hangers including 1" ASJ insulation in accordance with the applicable Division 22 Sections.
  - b. Unit of Measurement: Per lineal foot.
  - c. Quantity allowance to include in bid: 500 LF.
- 4. Unit Price P4: 1" Copper Pipe Type L
  - a. Description: Furnish and install 1-inch L copper domestic water piping and hangers including 1" ASJ insulation in accordance with the applicable Division 22 Sections.
  - b. Unit of Measurement: Per lineal foot.
  - c. Quantity allowance to include in bid: 400 LF.
- 5. Unit Price P5: 1-1/2" Black Steel Gas Pipe
  - a. Description: Furnish and install 1-1/2-inch black steel gas piping and hangers including exterior painting in accordance with the applicable Division 22 Sections.
  - b. Unit of Measurement: Per lineal foot.
  - c. Quantity allowance to include in bid: 500 LF.
- 6. Unit Price P6: 4" Cast Iron No-Hub Sanitary/Storm Pipe
  - a. Description: Furnish and install 4-inch cast iron no-hub sanitary/storm piping and hangers in accordance with the applicable Division 22 Sections.
  - b. Unit of Measurement: Per lineal foot.
  - c. Quantity allowance to include in bid: 400 LF.
- 7. Unit Price P7: 4" PVC Sanitary/Storm Pipe
  - a. Description: Furnish and install 4-inch PVC underground sanitary/storm piping in accordance with the applicable Division 22 Sections.
  - b. Unit of Measurement: Per lineal foot.
  - c. Quantity allowance to include in bid: 400 LF.
- 8. Unit Price P8: 6" Cast Iron No-Hub Sanitary/Storm Pipe
  - a. Description: Furnish and install 6-inch cast iron no-hub sanitary/storm piping and hangers in accordance with the applicable Division 22 Sections.
  - b. Unit of Measurement: Per lineal foot.
  - c. Quantity allowance to include in bid: 300 LF.
- 9. Unit Price P9: 6" PVC Sanitary / Storm Pipe
  - a. Description: Furnish and install 6-inch PVC underground sanitary/storm piping in accordance with the applicable Division 22 Sections.
  - b. Unit of Measurement: Per lineal foot.
  - c. Quantity allowance to include in bid: 300 LF.
- 10. Unit Price P10: Floor Drain type FD-A

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- a. Description: Furnish and install (1) FD-A floor drain in accordance with the applicable Division 22 Sections.
  - b. Unit of Measurement: Each.
  - c. Quantity allowance to include in bid: 10 EA.
11. Unit Price P11: Floor Drain type FS-1
- a. Description: Furnish and install (1) FS-1 floor sink in accordance with the applicable Division 22 Sections.
  - b. Unit of Measurement: Each.
  - c. Quantity allowance to include in bid: 5 EA.
12. Unit Price FP1: Sprinkler Head, Concealed
- a. Description: Furnish and install (1) pendant, concealed sprinkler in accordance with the applicable Division 21 Sections.
  - b. Unit of Measurement: Each.
  - c. Quantity allowance to include in bid: 40 EA.
13. Unit Price FP2: 1" Sprinkler Pipe
- a. Description: Furnish and install 1" threaded black steel pipe in accordance with the applicable Division 21 Sections.
  - b. Unit of Measurement: Per lineal foot.
  - c. Quantity allowance to include in bid: 500 LF.
14. Unit Price FP3: 1-1/2" Sprinkler Pipe
- a. Description: Furnish and install 1-1/2" threaded black steel pipe in accordance with the applicable Division 21 Sections.
  - b. Unit of Measurement: Per lineal foot.
  - c. Quantity allowance to include in bid: 400 LF.
15. Unit Price FP4: 2" Sprinkler Pipe
- a. Description: Furnish and install 2" black steel pipe in accordance with the applicable Division 21 Sections.
  - b. Unit of Measurement: Per lineal foot.
  - c. Quantity allowance to include in bid: 300 LF.

**END OF SECTION**

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SECTION 013234 WIRELESS CELLULAR CONSTRUCTION CAMERA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes a professional-grade 8 megapixel (3266 x 2450) construction camera. All hardware, software and time-lapse movie production services to be provided by a proven construction camera System Vendor.

1.2 CLOSEOUT SUBMITTALS

- A. Submit all original digital still images without alteration, manipulation, editing, or modifications using Image-editing software.
- B. Submit a professionally produced high-definition (1080) time-lapse movie of the project. Editing shall include image stabilization, color correction, removal of inclement weather footage and images outside the desired daily time range to be determined by Owner.

1.3 WARRANTY

- A. Manufacturer Warranty: Manufacturer agrees to repair or replace components of system that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Camera shall have a Lifetime Warranty including parts, labor and shipping.

1.4 SHIPPING

- A. All domestic shipping fees shall be included in the equipment price

1.5 OWNERSHIP DOCUMENTS

- A. All images and time-lapse footage shall be the property of the Owner

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Basis of Design - OxBlue Corporation  
Attn: Melissa Pottinger  
1777 Ellsworth Industrial BLVD  
Atlanta, GA 30318  
(404) 400-7617  
mpottinger@oxblue.com  
[www.OxBlue.com](http://www.OxBlue.com)
- B. Or Equal

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## 2.2. CAMERA

- A. Resolution: 8 megapixel (3266 x 2450)
- B. Wide angle lens standard
- C. Minimum 78 degree horizontal field of view
- D. Adjustable optical zoom

## 2.3 DATA CONNECTIVITY AND STORAGE

- A. Wireless (Cellular GPRS or CDMA) services provided by System Vendor
- B. Camera Memory: 48 hour minimum image buffer capacity for lost data connections
- C. Remote Storage: Unlimited storage of webcam images provided by System Vendor

## 2.4 POWER CONNECTION

- A. 120 / 240 VAC
- B. Power to Camera Provided by Electrical Contractor

## 2.5 DIMENSIONS AND WEIGHT

- A. Camera Dimensions: 21" L (53.34 cm) X 5.5" W (13.97 cm) X 4.25" H (10.795 cm)
- B. Mount Dimensions: 5.43" L (13.8 cm) X 6.71" W (17 cm) X F.7.78" H (19.8 cm)
- C. Weight: 17.5 lb (4.42 kg) installed

## 2.6 MOUNT

- A. Pole or wall mount provided by System Vendor
- B. Pole structure/bracing provided and installed by General Trades Contractors

## 2.7 OPERATING ENVIRONMENT AND CONTROLS

- A. -10 to 120 degrees F (-23 to 49 degrees C)
- B. 90% non-condensing
- C. 120 / 240 VAC units come standard with heater, blower and defroster; 12 VDC units come standard with blower

## 2.8 SOFTWARE

- A. Responsive software interface for use on computer, tablet and mobile screens
- B. Display Owner or Project logo on desktop software interface
- C. Dashboard display of all cameras
- D. Camera search capability
- E. Visual calendar showing actual photos from each day of the project
- F. Access to each individual photo archived
- G. Ability to schedule the automated delivery of images & time-lapses to users via email
- H. Display weather data with each image
- I. Ability to compare images from two cameras or two specific times simultaneously
- J. Ability to overlay and compare images from different times
- K. Interactive map showing project location
- L. Provide iPhone/iPad app and Android app

## 2.9 HOSTING AND WEBSITE INTEGRATION

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- A. Provide links to thumbnails of latest image at low, medium and high resolutions
- B. Provide API access for use in software and website integration

## 2.10 DATA SECURITY AND INFRASTRUCTURE

- A. Multiple access options including publicly available links, username authentication, IP restrictions and HTTPS communication protocols shall be available.
- B. Actual access method used shall be specified by Owner.
- C. Data shall be stored on redundant servers owned and managed by the System Vendor.

## PART 3 – EXECUTION

### 3.1 INSTALLATION

- A. It is the General Trade contractor's responsibility to meet all code requirements and to obtain any and all permits necessary.
- B. Installation of power service, provided by Electrical Contractor.
- C. Testing the camera for data connectivity at the jobsite prior to installation is recommended.

### 3.02 TESTING INSTRUCTIONS

- A. Connect the camera to an appropriate power source at the jobsite, and verify that the blue light, located on the bottom of the camera, is on.
- B. After 20 minutes, contact Technical Support to confirm image transmission.

## PART 4 – TIME-LAPSE MOVIE PRODUCTION

### 4.1 AUTOMATED ONLINE TIME-LAPSE MOVIES

- A. System shall automatically generate up-to-date (1080) high definition time-lapse movies throughout the duration of the project.
- B. Automatically generated time-lapse movies shall be available for download at any time.
- C. The online system shall intelligently select frames in order to produce time-lapse movies of an appropriate duration for viewing on the web, typically 30-60 seconds.

### 4.02 PROFESSIONALLY PRODUCED TIME-LAPSE MOVIE

- A. At the completion of the project the System Vendor shall produce one time-lapse movie of the project.
- B. The time-lapse movie shall be prepared based on the Owner's instructions for resolution, duration, date range, time range and audio as part of the service.

## PART 5 – PROPOSED CAMERA MOUNTING LOCATION

- A. Coordinate camera location with Architect and Owner in the field prior to installation.

END OF SECTION

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SECTION 013300 – SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Sections:
  - 1. Division 01 Instructions to Bidders, Section 16 "Substitutions".
  - 2. Division 01 General Requirements, Section 9 "Shop Drawings, Samples and Specifications".
  - 3. Division 01 General Requirements, Section 22 "Standards of Quality".

1.3 DEFINITIONS

**Action Submittals:** Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as action submittals.

**Informational Submittals:** Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections, or on the Drawings as informational submittals.

**Portable Document Format (PDF):** An open standard file format licensed by Adobe Systems used for representing documents in an electronic fixed-layout document format.

1.4 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the Architect and additional time for handling and reviewing submittals required by those corrections.
  - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
  - 2. Submittal: Submit concurrently with start-up construction schedule. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
  - 4. Format: Arrange the following information in a tabular format:
    - a. Scheduled date for first submittal.
    - b. Specification Section number and title.
    - c. Submittal category: Action, informational.
    - d. Name of subcontractor.
    - e. Description of the Work covered.
    - f. Scheduled date for Architect's final release or approval.

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- g. Scheduled dates for purchasing.
- h. Scheduled dates for installation.
- 5. Update: Update schedule as necessary throughout project to coincide with any major project schedule modifications.

#### 1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's/Engineer's Digital Data Files: Electronic copies of the Project Drawings of the Contract Documents may be available for Contractor's use in preparing submittals. The Contractor is responsible to contact the Architect and/or Engineer to arrange for such need.
  - 1. If available, the Contractor will need to sign and submit a data licensing agreement ("release") in the form acceptable to the Architect and/or Engineer.
  - 2. A fee may be charged by the Architect and/or Engineer for the time associated with the preparation and distribution of such electronic documents.
  - 3. If so arranged, the Architect/Engineer will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and As-Built drawings.
    - a. Architect or Engineer make no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
    - b. Digital Drawing Software Program: The Contract Drawings are available in AutoCAD Version 2010. If a different Version is required this can be arranged.
- B. 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 require sequential activity.
  - 2. Submit all submittal items required for each "system" concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  - 3. Submit action submittals and informational submittals required for the same "system" as separate packages under separate transmittals.
  - 4. 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.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
  - 1. Initial Review: Allow 10 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect/Engineer will advise the Contractor when a submittal being processed must be delayed for coordination.
  - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  - 3. Resubmittal Review: Allow 10 days for review of each resubmittal.
  - 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 15 days for initial review of each submittal.
  - 5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to the Engineer, allow 10 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
    - a. The Contractor is responsible for distribution of submittals to subcontractors and suppliers.

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- D. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect/Engineer will return submittals, without review or received from sources other than Contractor.
1. 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. Indication of full or partial submittal.
    - i. Remarks – including any additional relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations.
- E. Electronic Submission of Submittals is preferred method of architect and owner. Paper Submission to occur only on an as needed basis.
- F. Electronic Submission - Identification and Format: If submittals are transmitted electronically, identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a **single indexed pdf file** with links enabling navigation to each item. Only submittals provided in pdf form will be accepted. Word documents and Excel Documents will not be permitted.
  2. Each electronic submittal must be organized in same format with a singular page size per pdf submission. Sheets must be at least 8-1/2 by 11 inches but no larger than 30 by 42 inches. Do not mix different page sizes within the same submitted pdf file. This is to provide easy printing if necessary for review or recordkeeping.
  3. Name the file with submittal number or other unique identifier, including revision identifier.
    - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., VFES-022000.01). A second submittal for the same Specification Section would include the next sequential number (e.g., VFES-022000.01 for grass seed mixture; VFES-022000.02 for topsoil). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., VFES-061000.01.A).
  4. If not included on the transmittal, include the following information on an inserted page immediately following the transmittal:
    - a. Project name.
    - b. Date.
    - c. Name and address of Architect.
    - d. Name of Contractor.
    - e. Names of subcontractor, supplier and/or manufacturer.
    - f. Number and title of appropriate Specification Section.
    - g. Submittal Number (to match file name, see 3.a above)
    - h. Drawing number and detail references, as appropriate.
    - i. Location(s) where product is to be installed, as appropriate.
    - j. Related physical samples submitted directly.
    - k. Other necessary identification.
  5. The submission shall be reviewed by the Contractor prior to submission. The submitted materials shall conform to measurements at the site, the requirements of the Contract Documents and of all trades whose work must be coordinated with that shown on the Drawings. Submittal must include evidence of Contractor's review of the electronic submittal and shall bear the Contractor's stamp of approval, be dated and initialed. Documents that have been forwarded without review will be returned.



6. Email Distribution: Distribution of electronic submissions shall be done as follows:
    - a. Email must be sent directly to the Architect. The Architect will forward to necessary engineers or consultants for review. Architect's e-mail contact to be furnished to successful bidder.
    - b. Any additional persons whom should be notified of the submittal or reviewing the submittal concurrently may be copied (CC'd) on the same email.
    - c. The subject line should start with the submittal number and send only one submission per email. This format will improve digital storage and retrieval of submittals.
  7. Paper copies of all processed shop drawings and other submittals are to be available on site in the Contractor's field office for review during construction.
  8. The allowance of electronic submissions will be conditioned on the above being performed by the Contractor. If these requirements are not met, the Architect reserves the right to require paper copies for all submittals.
- F. Paper Submission - Identification and Format: Identify and incorporate information in each paper submittal as follows:
1. Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return without review submittals received from sources other than Contractor.
  2. On a submittal cover sheet or on the first page of the submittal, include the following information for processing and recording action taken:
    - a. Project name.
    - b. Date.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Name of subcontractor.
    - f. Name of manufacturer.
    - g. Submittal number or other unique identifier, including revision identifier.
      - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06100.01). A second submittal for the same Specification Section would include the next sequential number (e.g., NES-022000.01 for grass seed mixture; NES-022000.02 for topsoil). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06100.01.A).
    - h. Number and title of appropriate Specification Section.
    - i. Drawing number and detail references, as appropriate.
    - j. Location(s) where product is to be installed, as appropriate.
  3. The submission shall be reviewed by the Contractor prior to submission. The submitted materials shall conform to measurements at the site, the requirements of the Contract Documents and of all trades whose work must be coordinated with that shown on the Drawings. Submittal must include evidence of Contractor's review of the electronic submittal and shall bear the Contractor's stamp of approval, be dated and initialed. Documents that have been forwarded without review will be returned.
  4. Multiple Copies: Multiple copies of the submittal must be provided by the Contractor. Number of copies will be reviewed at the first job meeting. Generally, this would be such that the Architect, Engineer and the Owner can each retain one copy, plus the number required by the Contractor for record keeping and distribution to subcontractors and suppliers.
    - a. The Architect will make distribution of reviewed submittals to the Owner. The Contractor is responsible for distribution of reviewed submittals to subcontractors, manufacturers and suppliers.
    - b. Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

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- c. The Architect or Consulting Reviewer will not be responsible for producing additional copies of paper submissions.
- G. Options: Identify options requiring selection by the Architect.
- H. Deviations: Identify deviations from the Contract Documents on submittals. **Any changes from the Contract Documents shall be noted and highlighted.**
- I. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
  - 1. Note date and content of previous submittal.
  - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
  - 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- J. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- K. Use for Construction: Use only final submittals that are marked with approval notation from Architect's action stamp.

## PART 2 - PRODUCTS

### 2.1 SUBMITTAL REQUIREMENTS

- A. See the individual Technical Specification sections within this specification book for detail listings of each item that is to be submitted.
- 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 published 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 catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts, or if so specified, provide material samples for color selection.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  - 4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams showing factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.
    - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
- 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, unless submittal based upon Architect's digital data drawing files is otherwise permitted.

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1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
  2. 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.
  3. Submit Shop Drawings as a PDF electronic file or multiple paper copies.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  2. Process with a transmittal and provide the sample with a unique submittal number, in the same format as a shop drawing or product data.
  3. 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.
  4. 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.
    - a. Number of Samples: Submit one full set(s) 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, but will retain the material sample.
- E. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- F. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- G. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- H. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- I. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. 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.
- J. Field Test Reports: Submit reports 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 in the Contract Documents.

PART 3 - EXECUTION

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3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect/Engineer.
- B. 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. Contractor must sign and/or initial each approval stamp.

END OF SECTION 013300

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## SECTION 014000 - QUALITY REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Quality assurance requirements.
2. Quality control requirements.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -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 tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, Construction Manager Agent, or authorities having jurisdiction are not limited by provisions of this Section.
4. Specific test and inspection requirements are not specified in this Section.

#### 1.2 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.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Contractor's quality-control personnel.

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- B. 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 Architect.
  - 2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.
- C. Testing Agency Qualifications: 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.
- D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
  - 1. Specification Section number and title.
  - 2. Entity responsible for performing tests and inspections.
  - 3. Description of test and inspection.
  - 4. Identification of applicable standards.
  - 5. Identification of test and inspection methods.
  - 6. Number of tests and inspections required.
  - 7. Time schedule or time span for tests and inspections.
  - 8. Requirements for obtaining samples.
  - 9. Unique characteristics of each quality-control service.

#### 1.4 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include 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 reinspecting.

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- B. Manufacturer's Field Service Reports: Prepare written information documenting manufacturer's technical or factory-authorized representative's 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. 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.
- C. 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.

## 1.5 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
1. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of **five** 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.
- B. 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.
- C. 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.
- D. 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.
- E. 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 in material, design, and extent to those indicated for this Project.

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- F. Specialists: Certain Specification Sections 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.
  - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
  - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
  - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. 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.
- J. 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. 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 site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
    - d. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project.
  - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, through Construction Manager Agent, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:



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1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
  - a. Allow seven days for initial review and each re-review of each mockup.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed unless otherwise specified to remain as part of complete Work.

#### 1.6 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
  1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
  2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Contractor Responsibilities: 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.
  1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
    - a. Do not employ same entity engaged by Owner.
  2. Notify testing agencies at least 24 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.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including

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service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

- D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- E. Testing Agency Responsibilities: Cooperate with Architect, Construction Manager Agent, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
  - 1. Notify Architect, Construction Manager Agent, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  - 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
  - 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
  - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  - 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  - 6. Do not perform any duties of Contractor.
- F. 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.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -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.
- H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

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1. Distribution: Distribute schedule to Owner, Architect, Construction Manager Agent, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

#### 1.7 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner.

### PART 2 - PRODUCTS (Not Used)

### PART 3 - EXECUTION

#### 3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
  1. Date test or inspection was conducted.
  2. Description of the Work tested or inspected.
  3. Date test or inspection results were transmitted to Architect.
  4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and Construction Manager Agent's reference during normal working hours.

#### 3.2 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.
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

## SECTION 015639

### TEMPORARY TREE AND PLANT 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 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 311000 "Site Clearing" for removing existing trees and shrubs.

##### 1.3 DEFINITIONS

- A. Caliper (DBH): Diameter breast height; diameter of a trunk as measured by a diameter tape at a height 54 inches above the ground line.
- B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.
- D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

##### 1.4 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.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and locations of protection-zone fencing and signage, showing relation of equipment-movement routes and material storage locations with protection zones.
  - 2. Detail fabrication and assembly of protection-zone fencing and signage.
  - 3. Indicate extent of trenching by hand or with air spade within protection zones.
- C. 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.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For arborist and tree service firm.
- B. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to 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.

## 1.7 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.

## 1.8 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.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Backfill Soil: 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. Planting Soil: Planting soil as specified in Section 329113 "Soil Preparation".
- 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.
  2. 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 (13.8 MPa) and ultimate tensile strength of 2680 psi (18.5 MPa); 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 (2400 mm) apart.
    - a. Height: 48 inches.
    - b. Color: High-visibility orange, nonfading.

### 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. Tie a 1-inch blue vinyl tape around each tree trunk at 54 inches 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 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 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. Chain-Link Fencing: Install to comply with ASTM F567 and with manufacturer's written
2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Engineer.

B. Maintain protection zones free of weeds and trash.

C. 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.

### 3.4 EXCAVATION

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 312000 "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.
- C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches (75 mm) back from new construction and as required for root pruning.
- D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

### 3.5 ROOT PRUNING

- A. Prune tree roots that are affected by temporary and permanent construction. Prune roots 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 redirected and covered with soil.
4. Cover exposed roots with burlap and water regularly.
5. Backfill as soon as possible according to requirements in Section 312000 "Earth Moving."

- B. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.

### 3.6 CROWN PRUNING

- A. Prune branches that are affected by temporary and permanent construction. Prune branches 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 according to ANSI A300 (Part 1).
- B. Unless otherwise directed by arborist and acceptable to Engineer, 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.

### 3.7 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.

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- D. Minor Fill within Protection Zone: Where existing grade is 2 inches 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.

### 3.8 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.

### 3.9 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 according to 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 or are damaged during construction operations that Engineer 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 two new tree(s) of 4-inch caliper size for each tree being replaced that measures more than 4 inches (100 mm) in caliper size.
      - a. Species: As selected by Engineer/Landscape Architect.
    - 3. Plant and maintain new trees as specified in Section 329300 "Plants."
  - C. Excess Mulch: Rake mulched area within protection zones, being careful not to injure roots. Rake to loosen and remove mulch that exceeds a 2-inch uniform thickness to remain.
  - D. Soil Aeration: Where directed by Engineer, aerate surface soil compacted during construction. Aerate 10 feet beyond drip line and no closer than 36 inches to tree trunk. Drill 2-inch- diameter holes a minimum of 12 inches (300 mm) deep at [24 inches Backfill holes with an equal mix of augered soil and sand.
- ### 3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS
- A. Disposal: Remove excess excavated material, displaced trees, trash, and debris and legally dispose of them off Owner's property.

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END OF SECTION 015639

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SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

1.2 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

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- B. Submittals Prior to Substantial Completion: Complete the following a minimum of **10** days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  2. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  3. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Owner. Label with manufacturer's name and model number where applicable.
    - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.
  4. Submit test/adjust/balance records.
  5. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of **[10]** days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
  2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  3. Complete startup and testing of systems and equipment.
  4. Perform preventive maintenance on equipment used prior to Substantial Completion.
  5. Advise Owner of changeover in heat and other utilities.
  6. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
  7. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  8. Complete final cleaning requirements, including touchup painting.
  9. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager Agent will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect 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, that must be completed or corrected before certificate will be issued.

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1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
  - a. When more than one reinspection is required, pay for Architect's time to complete additional reinspections.
2. Results of completed inspection will form the basis of requirements for final completion.

#### 1.6 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
  1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
  2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  4. Submit pest-control final inspection report.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager Agent will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect 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.
    - a. When more than one reinspection is required, pay for Architect's time to complete additional reinspections.

#### 1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use CSI Form 14.1A or other Architect approved form.
  1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
  2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

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3. Include the following information at the top of each page:
  - a. Project name.
  - b. Date.
  - c. Name of Architect and Construction Manager Agent.
  - d. Name of Contractor.
  - e. Page number.
4. Submit list of incomplete items in the following format:
  - a. MS Excel electronic file. Architect, through Construction Manager Agent, will return annotated file.

#### 1.8 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within [15] days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
  1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
  2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark 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 Installer.
  3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
  4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

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## 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: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
  - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
    - 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. Remove snow and ice to provide safe access to building.
    - f. 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.
    - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - h. Sweep concrete floors broom clean in unoccupied spaces.
    - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
    - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
    - k. Remove labels that are not permanent.



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- l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
    - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
  - o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
  - p. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

### 3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
  - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
  - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
    - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
  - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
  - 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy fixtures to comply with requirements for new fixtures.

END OF SECTION

SECTION 02110

SITE CLEARING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. General: Remove trees, shrubs, grass and other vegetation, improvements, or obstructions interfering with installation of new construction. Remove such items within the easement limits and within the public right-of-ways as shown on the drawings and as specified herein. Removal includes digging out stumps and roots.
- B. Site clearing includes, but is not limited to:
  - 1. Protect existing trees to remain.
  - 2. Clear and grub all trees and vegetation where construction activities of the project will be conducted.
  - 3. Topsoil stripping and stockpiling on site.
  - 4. Dispose of vegetation and other debris resulting from clearing operations.
  - 5. Remove existing pavements and bases as shown on the drawings.
  - 6. Dispose of all tree stumps resulting from the clearing operations.
  - 7. Remove existing obstructions interfering with installation of new construction.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Soil Erosion and Sediment Control - Section 02120
- B. Rough Grading - Section 02210
- C. Rock Removal - Section 02211
- D. Finish Grading - Section 02260

1.3 ACCESS AND USE OF SITE

- A. All of Contractor's operation shall be limited to the easements or right-of-ways shown on the drawings.

1.4 PROTECTION

- A. Protect existing trees and other vegetation indicated to remain in place, against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by

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stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.

- B. Provide protection for roots over 1-1/2" diameter cut during construction operations. Coat cut faces with an emulsified asphalt, or other acceptable coating, formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.
- C. Repair or replace trees and vegetation indicated to remain which are damaged by construction operations, in a manner acceptable to the Engineer. Employ licensed arborist to repair damages to trees and shrubs.
- D. Protect trees, shrubs, lawns, areas to receive planting, rock outcropping and other features remaining as part of final landscaping.
- E. Protect bench marks and existing structures, roads, sidewalks, paving and curbs against damage from vehicular or foot traffic.
- F. Streets, roads, adjacent property and other works to remain shall be protected throughout the work.
- G. Protect existing improvements and amenities outside the limits of work. Restore damaged improvements to their original condition. Protect existing amenities within the limits as shown on drawings.
- H. Maintain designated temporary roadways, walkways and detours, for vehicular and pedestrian traffic.
- I. Trees outside of public right-of-ways and easement limits shall remain.
- J. The Contractor shall neither damage nor destroy any trees or shrubs not located in the permanent or temporary easements or public right-of-way. Any trees or shrubs damaged or destroyed that are located outside of the permanent or temporary easements or public right-of-way shall be replaced in kind by the Contractor at no additional cost to the Owner.
- K. Street trees located within the public right-of-way removed by the Contractor shall be replaced in kind by the Contractor at no additional cost to the Owner.

## 1.5 JOB CONDITIONS

### A. Environmental Protection

1. Contractor shall take whatever precautions are necessary to prevent soil erosion, water pollution, and other conditions detrimental to the environment. Should such environmentally detrimental conditions develop due to site clearing operations, Contractor shall correct the conditions immediately. All measures of sediment and erosion control indicated on the plans and in the specifications shall be followed.

2. Contractor shall not permit human waste, garbage, kitchen or laundry wash, manure,

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sawdust, or other environmentally destructive material to enter any spring, stream, water course, pond, lake or wetland. All such materials shall be removed from the site on a periodic basis and at the completion of the work.

B. Existing Roads

1. Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent facilities. Do not close or obstruct streets, walks or other occupied or used facilities prior to Engineer approval.

PART 2 - PRODUCTS

2.1 DEFINITIONS

A. TOPSOIL

1. Friable clay loam surface soil found in depths not less than four inches. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over one inch in diameter, and without weeds, roots, and other objectionable material.

B. FILL

1. Suitable soil materials are defined as those complying with ASTM D2487 soil classification Groups ML, GW, GP, GM, SW, SM and SP. Suitable soil materials shall consist of residual soils and/or decomposed rock obtained from required on site excavations. Suitable soil materials shall be free of organic matter, ice, snow, and shall not contain rock fragments greater than six (6") inches in diameter.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Maintain bench marks, monuments and other reference points. Reestablish if disturbed or destroyed, at no cost to the Owner.
- B. Layout the Work in accordance with drawings and reference points. Protect all reference stakes, and bench marks and replace if disturbed or removed without prior approval.

3.2 SITE CLEARING

- A. When required, with the Engineer's approval carefully and cleanly cut roots and branches of trees indicated to be left standing, where such roots and branches obstruct new construction.
- B. Strip existing topsoil in areas designated for excavation. Stockpile topsoil for later use.
  1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material.
    - a. Remove heavy growths of grass from areas before stripping topsoil. Strip to

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sufficient depth to remove the main root system.

2. Stockpile topsoil in storage piles. Construct storage piles to freely drain surface water. Cover storage piles if required to prevent wind-blown dust. Stockpiled topsoil is to be protected from erosion by establishing a cover of annual grass.
  3. Dispose of excess clean topsoil as directed by the Engineer.
- C. Clearing and Grubbing: Clear site of trees, shrubs and other vegetation, except for those indicated to be left standing.
1. Completely remove stumps, roots, and other debris protruding through ground surface. Include the removal of brush, roots, matted leaves and other foreign matter, so that earth stripping as specified will be topsoil only.
  2. Use only hand methods for grubbing inside drip line of trees indicating to be left standing.
  3. Fill depressions caused by clearing and grubbing operations with suitable soil material, unless further excavation or earthwork is indicated.
    - a. Place fill material in horizontal layers not exceeding 6" loose depth, and thoroughly compact to a density equal to adjacent original ground.
- D. Where "selective clearing" is noted, clear the area of all trash, debris and trees marked for removal without injury to the existing plant materials, natural ground condition, and without disturbing the forest floor. Deadwood and matted leaves may remain in these areas.
- E. Remove embedded rock or boulders 1/2 cubic yard or less.
- F. Remove trees conflicting with new construction work which are not identified to remain. Include removal of tree stumps and the filling of stump holes with approved and compacted fill material, unless earthmoving operations immediately follows stump removal.
1. Perform clearing and grubbing of tree stumps without damage to trees designated to remain. Remove stumps individually by pulling in a direction away from the existing trees to remain. Do not use large earth-moving equipment in a push-out method since adjacent roots would be damaged. Where removing the entire stump is not possible without damaging adjacent existing trees, grind stumps to a depth of 12 inches below grade.
  2. For grading work in areas where existing trees are to remain, use small earth-moving equipment or do work by hand to the extent that tree roots are not damaged by work methods or by over-compaction of soil.
- G. Removal of Improvements: Remove existing improvements necessary to permit construction, and other work as indicated on the drawings.
- H. Protection of Existing Trees to Remain: All existing trees within Contract limit line to remain shall be protected by snow fence or similar type barrier approved by Engineer.

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3.3 DISPOSAL OF EXCESS AND WASTE MATERIALS

- A. All stumps, brush, pavement and waste material generated by clearing operations shall become Contractor's property and shall be removed from the site for safe, legal, off-site disposal.
- B. Material to be removed shall be removed from the site daily as it accumulates. Should the Contractor receive approval to continue work beyond normal working hours, material to be removed shall not be allowed to accumulate for more than 48 hours.

END OF SECTION

SECTION 02210

ROUGH GRADING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work includes but is not limited to:

1. Preparation of subgrades for all foundations, slabs, pavements, walks, etc.
2. General site grading.
3. Excavation and backfill for all utility systems.
4. Excavation and backfill for foundations, slabs on grade, and other concrete for buildings and structures.
5. Excavation and backfill for other Division 2 work not covered elsewhere.
6. Drainage course for building slabs on grade.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

- A. Soil Erosion and Sediment Control - Section 02120
- B. Structure Excavation, Backfill, and Compaction - Section 02220
- C. Utility Excavation, Backfill, and Compaction - Section 02221
- D. Finish Grading - Section 02260

1.3 REFERENCE STANDARDS

- A. Pennsylvania Department of Transportation (PennDOT), Publication 408, "Specifications", latest edition.
- B. American Association of State Highway and Transportation Officials (AASHTO).
- C. American Society of Testing and Materials (ASTM)
  - D 448 Specification for Standard Sizes of Coarse Aggregate for Highway Construction.
  - D1557 Test Methods for Moisture - Density Relations of Soils and Soil Aggregate. Mixtures using 10 lb. rammer and 18 in. drop.

D2487 Classification of Soils for Engineering Purposes.

D2922 Density of Soil and Soil Aggregate in Place by Nuclear Methods.

D3017 Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods.

#### 1.4 DEFINITION

- A. "Excavation" consists of removal of material encountered to subgrade elevations indicated and subsequent disposal of materials removed. Excavation shall be unclassified. If any unforeseen conditions are found, notify the Engineer before proceeding with work.

#### 1.5 QUALITY ASSURANCE

- A. Codes and Standards: Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

#### 1.6 JOB CONDITIONS

- A. Site Information: Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings or probes. It is expressly understood that the Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data are made available for convenience of Contractor.

Additional test borings and other exploratory operations may be made by Contractor at no cost to the Owner.

- B. Provide minimum of 72 hour notice to Engineer and Utility Company, and receive written notice to proceed before interrupting any utility.
- C. Use of Explosives: Do not bring explosives onto site or use in work without prior written permission from the Engineer. Contractor is solely responsible for handling, storage, permits and use of explosive materials when their use is permitted.
- D. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.

Operate warning lights as recommended by authorities having jurisdiction.

Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

Perform hand excavation within drip-line of large trees that are to remain, and protect the root system from damage or dryout to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with burlap. Paint root cuts of 1" diameter and larger with emulsified asphalt tree paint. Keep equipment beyond drip-line of trees to remain.



## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS

#### A. Definitions:

1. Suitable soil materials are defined as those complying with Unified Soil Classification System soil classification Groups GW, GP, GM, SW, SM and SP. Suitable soil materials shall consist of residual soils and/or decomposed rock obtained from required on site excavations. Suitable soil materials shall be free of organic matter, ice, snow, and shall not contain rock fragments greater than six (6") inches in diameter.
2. Unsatisfactory Soil Materials: Unsatisfactory soil materials are defined as those in the Unified Soil Classification System classes GC, SC, ML, CL, OL, MH, CH, OH and PT, and other highly organic soils.

#### B. Soil Backfill and Fill Materials: Provide satisfactory materials for backfill and fill, free of debris, waste, frozen materials, vegetation, and other deleterious matter.

1. Use on-site excavated or off-site borrow material that has been sampled, tested and certified as satisfactory soil material.
2. Use approved satisfactory soil materials as backfill in all excavations required for the construction of new foundation, meter pits, underground electrical, and plumbing.
3. All backfill placed shall be compacted and tested as specified herein.

#### C. Offsite Borrow shall consist of suitable soil materials which are required on the project site and must be brought onto the site from an approved borrow pit. Offsite borrow shall only be utilized upon written authorization by the Engineer. Available on-site borrow shall be utilized prior to requesting use of off-site borrow.

#### D. Geotextiles shall conform to PennDOT specification Section 212.2 and 735.

#### E. Structural backfill, floor, and subbase materials shall be PennDOT No. 2A modified, AASHTO No. 57, or K-Krete capable of safely sustaining a superimposed load of 2,000 lbs/sq ft. unless otherwise indicated or specified.

#### F. Contractor shall control moisture content for all soil materials; moisture content shall not impact designation of "satisfactory" or "unsatisfactory" soil materials.

## PART 3 - EXECUTION

### 3.1 EXCAVATION

- #### A. General: Excavation consists of removal of material encountered to subgrade elevations indicated and subsequent disposal of materials removed. Areas within the building lines, pavements, and embankments shall be stripped of all vegetation, tree stumps, topsoil and

existing pavements. All areas requiring fill or where foundations, pavements, etc. are to be placed shall be proof rolled. Existing facilities including roads, pavements, etc. shall be removed as noted on the plans. Voids caused by such removal shall be backfilled with satisfactory soil material. Cap all existing pipes as called for on the plans.

- B. Excavation: All excavation on the project shall be unclassified. Contractor shall be responsible to remove whatever materials are encountered in establishing the subgrades shown on plans and described in specifications. No additional compensation shall be allowed the Contractor for any rock, pavements, foundations, etc. which are encountered and must be removed in order to establish such subgrades. Contractor may use mechanical equipment, hand methods, or explosives when and where authorized by the Engineer to remove such materials as he/she elects as long as such use is within the guidelines and requirements of these specifications.

C. Unauthorized Excavation:

1. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of the Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be at Contractor's expense.
2. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position, when acceptable to the Engineer.
3. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed the Engineer.

D. Undercut Excavation:

1. When excavation has reached required subgrade elevations, notify the Engineer who will make an inspection of conditions.
2. If unsatisfactory bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material as directed by the Engineer.

E. Stability of Excavations:

1. Slope sides of excavations to comply with applicable codes, regulations, and ordinances having jurisdiction and to maintain safe working conditions. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
2. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

F. Dewatering:

1. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
2. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
3. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or runoff areas. Do not use trench excavations as temporary drainage ditches.
4. The cost for drying soil materials which are unsuitable only because they are wet shall be borne by the Contractor.
5. Water from pumping must be properly filtered before discharging.

G. Material Storage:

1. Segregate and stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.
2. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.
3. Dispose of excess soil material and waste materials as herein specified.

H. Excavation for Pavements:

1. Adjust rough graded surface under pavements to comply with elevations and grades as shown.

I. Cold Weather Protection:

1. Protect excavation bottoms against freezing when atmospheric temperature is less than 35oF.

### 3.2 GROUND SURFACE PREPARATION

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- A. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fill. Plow, strip, or break-up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.
- B. The bottom of all excavations and all areas to receive fill and backfill shall be approved by the Engineer before any construction takes place. All foundation subgrades and an area 10 feet wide in all directions from the foundation shall be compacted to a minimum of 95 percent (95%) of the maximum modified dry densities as determined by ASTM D1557 before any fill, aggregate bases, pavements, or foundations are placed upon them.

### 3.3 PROOF ROLLING

- A. Equipment used for proof rolling shall be self propelled vibratory steel drum roller imparting a total static and dynamic force of at least 300 pounds per inch of drum width.
- B. Proof roll area before filling begins, to detect soft or yielding soils. Correct soft or yielding areas by scarifying and drying or moistening as conditions warrant.
- C. Recompact and proof roll area again to verify soil stability.
- D. If, in the opinion of the Owner or Engineer the unstable areas require undercutting, undercut the area as directed and refill with satisfactory material. Refer to Paragraph 3.1.

### 3.4 EMBANKMENT AND COMPACTION

- A. General: Control soil compaction during construction providing minimum percentage of density specified for each area classification as indicated below.
- B. Control soil compaction during construction for compliance with the percentage of maximum dry density specified in accordance with ASTM D1557.
- C. Place fill in approximately horizontal lifts with a loose thickness of not more than 8" (eight inches) for material compacted by heavy compaction equipment 4" (four inches) for material compacted by hand operated tampers.
- D. Percentage of Maximum Density Requirements: All fill and backfill, shall be compacted in maximum 8-inch thick lifts to a minimum of 95 percent of maximum dry density. During placement and compaction, the moisture content of fill, backfill and structural backfill material shall be not more than 2 percent above or below the optimum moisture content. Compacted fill under foundation slabs and footings shall be compacted in maximum 8-inch thick lifts to a minimum of 98 percent of maximum dry density. Non-structural compacted fill shall be compacted to a minimum of 92 percent of maximum dry density.
- E. The moisture content of the fill materials shall be adjusted, if necessary, by aeration or sprinkling, so as to be within plus or minus two percentage points of the optimum moisture content determined in the laboratory.
- F. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

- G. Soil material that has been removed because it is too wet to permit compaction shall be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

### 3.5 GRADING

- A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finish surfaces within adjacent transition areas. Smooth finish surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.
- B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Follow requirements of plan. Finish surface free from irregular surface changes, and as follows:
  - 1. Lawn or Unpaved Area: Finish areas to receive topsoil shall be graded to within not more than 0.10 foot above or below required subgrade elevations.
  - 2. Walks: Shape surface of areas under walks to line, grade and cross section, with finish surface not more than 1" above or below required subgrade elevation.
  - 3. Pavements: Shape surface of areas under pavement to line, grade and cross section, with finish surface not more than 1/2" above or below required subgrade elevation.
- C. Grading Surface of Fill Under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2" when tested with a 10' straightedge.
- D. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

### 3.6 FIELD QUALITY CONTROL

- A. Tests to determine conformance with all requirements for all Contractor-secured materials proposed for use shall be performed by an independent commercial laboratory retained and compensated by the Contractor and approved by the Engineer.
- B. On-site quality control testing shall be performed during construction to determine conformance with plans and specifications by an independent laboratory retained and compensated by the Contractor and approved by the engineer.
- C. Quality Control Testing During Construction: Allow testing services to inspect and approve subgrades and fill layers before further construction work is performed.

### 3.7 MAINTENANCE

- A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

- B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.
- C. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

### 3.8 DISPOSAL OF EXCESS AND WASTE MATERIALS

- A. Excess or unsatisfactory materials excavated on the site which cannot be used in fill or embankment areas shall be removed from the site and disposed of by the Contractor. The Owner shall have the right of first refusal of this material. Should the Owner elect to use the material, the Contractor shall dump the material at any reasonable location on the Owner's property, but shall not be responsible for grading or other work on such dumped materials.

END OF SECTION

SECTION 02221

UTILITY EXCAVATION, BACKFILL AND COMPACTION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Furnish all labor, materials and equipment to do all clearing of work areas, excavation to the depth shown and/or indicated, support of utilities, maintenance of excavation, removal of all water, backfilling, additional fill, disposal of excess fill, grading, compaction and all incidental work to complete earthwork for foundation and utility construction as shown on drawings, as specified and/or as directed by the Engineer.
- B. All excavation shall be unclassified and shall include all materials excavated regardless of character. No specific payment will be made for excavation. The prices bid for the respective items shall include all excavation and backfill. Excavation shall be in open cut, unless written permission is given by the Engineer to excavate by other methods. The Engineer shall be empowered to require under special circumstances (such as fragile utilities nearby) that hand excavation and backfill be employed within reasonable limits and accepted construction practices, and that no extra compensation will be allowed the contractor for the hand excavation. It shall be the responsibility of the contractor to plan the trench work to avoid conflicts, obstructions, etc.

No additional payment will be made for rock excavation.

- C. All work shall be in accordance with OSHA Safety and Health Standards (29CFR 1910), Revised July 1, 1989, or latest revision.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Rough Grading - Section 02210
- B. Rock Removal - Section 02211
- C. Pressure Pipe, Materials, Valves, Appurtenances and Testing - Section 02616
- D. Gravity Sanitary Sewer System - Section 02722

1.3 REFERENCE STANDARDS

- A. Pennsylvania Department of Transportation (PennDOT) Publication 408, Specifications dated 1990, or latest revision
- B. American Society for Testing and Materials (ASTM)

D1556 Density of Soil in Place by the Sand Cone Method

D1557 Moisture - Density Relations of Soils and Soil Aggregate Mixtures Using 10 lb. Rammer and 18 in. Drop.

D2922 Density of Soil and Soil Aggregate in Place by Nuclear Methods

D3017 Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods

C. OSHA Safety and Health Standards (29CFR 1910), Revised July 1, 1989.

#### 1.4 QUALITY ASSURANCE

A. The services of qualified inspection and testing agencies shall be used for this work.

#### 1.5 BLASTING

A. When permitted by the Engineer, blasting shall be done by experienced and approved blasters. All blasts shall be carried out in strict accordance with existing ordinances of the State, County or Municipality governing same and Federal blasting regulations. Blasts shall be fired at such times as may be directed by the Engineer. The Engineer shall also have the right, if necessary, to regulate the number and size of charges.

#### 1.6 ACCOMMODATION OF TRAFFIC

- A. The Contractor shall, where required, maintain roads open for traffic with satisfactory barricades, warning signs and lights. Where permission for detouring traffic is granted, the Contractor shall post detour signs, to satisfaction of the Authorities, the Contractor shall maintain such detour routes. During progress of the work, sidewalks and crossings shall be kept open for passage of pedestrians, unless otherwise authorized.
- B. The Contractor shall furnish, place and maintain safety fence around all excavations and other areas designated by the Engineer during non-work hours. Safety fencing shall be the product of Tenax Corporation, bright orange, no less than five feet in height, or approved equal.
- C. All excavated and backfill material shall be completely removed from the site at the end of each work day. In no instance shall excavated and backfill material be stockpiled within the Township right-of-way or on private property unless written permission is given by the Engineer.
- D. The Contractor shall make every effort to clean up the work area at the end of each work day. A power broom shall be used to remove dirt and debris from the roadway.
- E. The Contractor shall construct and maintain, without compensation, adequate and approved bridges over excavations as may be necessary or directed by the Engineer for purpose of accommodating pedestrians or vehicles.
- F. All fire hydrants, water valves, and fire alarm boxes shall be left uncovered and readily accessible for use.

#### 1.7 PROTECTION OF PROPERTY AND STRUCTURES



- A. The Contractor shall at his own expense, sustain in their places and protect from direct or indirect injury, all pipes, conduits, poles, tracks, walls, buildings, pavement, guiderails, driveways, curb, street signs, sidewalks, lawns, fields, mailboxes, shrubs, bushes, plantings, and other structures or property in vicinity of his work, whether above or below ground. He shall replace any pipe, if in the opinion of the Engineer, it is a functioning pipe. Contractor shall restore, at his own expense, any existing property damaged by construction activity. Restoration, when complete, shall render the disturbed area equal to or better than its original condition prior to construction.
- B. The Contractor shall have sufficient sheeting or shoring available for supporting his excavations and for sustaining or supporting any structures that are uncovered, undermined, endangered, threatened or weakened.

#### 1.8 OBSTRUCTION SHOWN ON DRAWINGS

- A. When the drawings show information in addition to structures and systems to be built, such as locations of pipes, conduits and other structures which exist along lines of work below and/or above the surface of the ground, said information is shown for the convenience of the Contractor who must verify in advance the information given to his own satisfaction.

#### 1.9 REMOVAL AND STORAGE OF SURFACE MATERIALS

- A. The Contractor shall grub and clear surface and remove all surface materials, of whatever nature, over line of trench and site of other structures; and he shall properly store, guard and preserve such of said materials as may be required for use in backfilling, resurfacing, repaving, or for other purposes. All curb, gutter, sidewalk and all paving material which may be removed, together with all materials taken from trenches, may be stored in such parts of the roadway or such other suitable place as shall be approved and directed. However said material must be removed from the roadway at the end of each day. The Contractor shall be responsible for any loss of or damage to curb, gutter, sidewalk, flagstones, paving material, grass and plantings through their careless removal or neglectful or wasteful storage, disposal or use.
- B. The Contractor shall have no claim for extra compensation for removal of trees or for excavation by hand or tunnel in vicinity of trees that may be left standing.

#### 1.10 WORK IN TOWNSHIP ROADS

- A. The Contractor shall remove paving to the maximum allowable trench width, only, as is necessary for the excavation of the trench, and in cases where he removes paving for a greater width than is necessary, or in case where he removes or disturbs or damages any paving outside the maximum allowable trench width, the Contractor will repair or replace the paving per the specifications (6 inches of BCBC and 1 inch of wearing course) and the Contractor shall have no claim for extra compensation for this work.
- B. For roadway excavation or rehabilitation, saw cutting shall be employed for removal of existing pavement to neat lines, as indicated by the contract documents or directed by the engineer.

#### 1.11 OBSTRUCTIONS AND MAINTENANCE OF SERVICES

- A. Any work on poles, pipes, conduits or other structures belonging to utility companies that the Authority agrees that they are in direct conflict with the proposed facilities specified herein and requires removal, realignment or change, because of work to be done under the contract, will be done as an extra, or by the Owner of the structure without costs to the Contractor. However, the Contractor shall be required to relocate any residential utility services in conflict with the proposed facilities and adjust any valve boxes for paving or grading and work around utility poles and underground utilities, pipes, conduits or other structures which are not in direct conflict with the work. Residential utility service relocations shall be performed at no additional cost to the Owner. The Contractor shall arrange with all utility companies for any relocation, temporary removal and restoration of their facilities when required for prosecution of work. However, the Contractor shall uncover and support said structures within the limits of his trench and shall not be entitled to any claim for damage or extra compensation because of said structure or because of any delay in removal or rearrangement of same.
- B. There shall be maintained at all times a continuous flow in all existing gas, water, sewer, conduit, electric power, and telephone lines, or any other pipes or structures encountered in prosecution of work under this project, whether above or below ground surfaces.

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS

#### A. Definitions:

- 1. Suitable soil materials are defined as those complying with unified soil classification system soil classification Groups GW, GP, GM, SW, SM and SP. Suitable soil materials shall consist of residual soils and/or decomposed rock obtained from required on site excavations. Suitable soil materials shall be free of organic matter, ice, snow, and shall not contain rock fragments greater than six (6) inches in diameter.
  - 2. Unsatisfactory Soil Materials: Unsatisfactory soil materials are defined as those in the Unified Soil Classification System classes GC, SC, ML, CL, OL, MH, CH, OH and PT, and other highly organic soils.
- 2.2 No ashes, decomposable refuse, large stones, or other material of an unsatisfactory character shall be used in backfilling. All satisfactory excess material from trenches and other excavations in the contract shall be used and all costs for placement shall be included in the price bid.
  - 2.3 In the event that additional material is needed, the Contractor shall obtain borrow material from other sources. All borrowed material shall be of satisfactory quality for required purposes. In certain locations, grading and filling of adjacent ground may be required or directed by the Engineer. Payment for furnishing and placing borrowed material shall be included in prices bid.

## PART 3 - EXECUTION

### 3.1 TRENCHING

#### A. Trench Width and Depth:

1. Trenches shall be excavated to necessary width and depth, as specified herein or as directed. Where sheeting is used the maximum width below top of pipe shall be measured between interior faces of sheeting as driven, but in no case shall stringers or waling-strips be so placed as to interfere with proper ramming of earth under and around pipe.
2. If sheeting does not extend below a point six (6) inches above pipe as laid, the maximum width allowed shall be measured between faces of excavation below bottom of sheeting.
3. Sides of trenches shall be practically plumb and under no circumstances will they be permitted to be sloped unless approved by the Engineer. The maximum allowable trench width shall be two (2) feet wider than outside diameter of pipe. Where more than one pipe is placed in a trench, a maximum clear distance of 12" shall be allowed from the wall of the nearest pipe.
4. Where, in the opinion of the Engineer the grade is suitable for foundation of work, the bottom of the trench shall be excavated flat to receive pipe and the bottom of trench under each joint or coupling hollowed out to allow for making joints.
5. Trenches excavated below proper grade, excepting at joints, shall be filled to proper grade with satisfactory material thoroughly rammed, to insure adequate support and stability of pipe or other structures.
6. Where rock is encountered, carry excavation 6 inches below required elevation and backfill with a 6 inch layer of AASHTO No. 57 coarse aggregate.

#### B. Trench Length:

1. No greater length of trench shall be left open, in advance of completed structure placed therein, than shall be authorized or directed by the Engineer. The Engineer shall be empowered at anytime to require backfilling of open trenches over completed pipe lines, if in their judgement such action is necessary. The Contractor shall have no claim for extra compensation, even though to accomplish said backfilling he may be compelled to temporarily stop excavation or other work.
2. If work is stopped on any trench, for any reason except by order of the Engineer, and excavation is left open for an unreasonable length of time in advance of construction, the Contractor shall, if so directed, backfill such trench at his own expense, and shall not again open said trench until he is ready to complete structure therein. If the Contractor refuses or fails to backfill such trench completely within eight (8) hours the Owner shall authorize the work to be performed by other forces, and the Owner shall charge expense thereof to the Contractor and retain same out of any monies due or to become due him under the contract.

3. Unless otherwise authorized, excavation of trenches may be fully completed no more than (100) feet in advance of pipe laying.

**4. No trench shall be left open at the end of each work day.**

- C. Change of Trench Locations: Where the Engineer directs that the proposed location of a trench be changed, due to unforeseen conditions, the Contractor shall not be entitled to a claim of extra compensation, provided that the Contractor is notified of the change before excavation is begun. If a change, made at the direction of the Engineer, involves abandonment of an excavation already made, the abandoned excavation, together with necessary backfill will be classed as miscellaneous excavation and shall be paid as such.

In the event that the trench is abandoned at the Contractor's request, the abandoned excavation and backfill shall be at the Contractor's expense.

- D. Preparation of Foundation: All irregularities and cavities, either in earth or rock excavation, in bottom of trenches or tunnels, shall be filled to required level with satisfactory fill material, and compacted, before pipe lines are laid therein.

E. Sheet piling and Shoring:

1. The Contractor shall support sides and ends of all excavations or structures, when necessary or directed, with braces, sheet piling, shores or stringers of quality and character required. All timbering or underpinning shall be placed or driven by men skilled in such work and shall be arranged so that it may be withdrawn as backfilling proceeds, without injury to structures built or adjacent structures or properties.

2. If, in opinion of the Engineer, the material furnished for timbering excavation is not of proper quality or size, or is improperly placed, the Contractor shall, upon notice, procure and place satisfactory timbering, or place said timbering in a satisfactory manner. Upon his failure to do so, work may be ordered stopped until said notice shall have been complied with and the Contractor shall not be entitled to any claim for extra compensation, for damage or delay.

3. Timbering in excavations may be withdrawn as the backfilling is being done, except to such extent as the Engineer shall order that said timbering be left-in-place. The Contractor shall cut off any sheet piling left-in-place, at least 12 inches below finished grade where ordered by the Engineer and shall remove cut-off material without compensation for either material removed or material cutting and removal.

F. Dewatering Excavations:

1. There shall be provided and maintained at all times during construction of work, ample means and devices, including all necessary equipment, power and labor to pump, bail or otherwise promptly remove and properly dispose of all water and/or sewage entering, or found in the excavations, trenches or other parts of work. Well points shall be utilized wherever necessary to maintain dry conditions throughout working areas.

2. All costs for dewatering shall be included in bid price.

3. Method used to accomplish dewatering must meet with the Engineer's approval.
4. Existing piping shall not be used for drainage of excavation or trenches.
5. When in quicksand or soft ground, or for protection of any structure or property, sheeting shall be driven to a depth below bottom of excavation as may be required without extra compensation.
6. Water from pumping must be properly filtered before discharging.

G. Responsibility for Condition of Excavation:

1. The Contractor shall be solely responsible for condition of all his excavations, and any slides or cave-ins shall be removed without extra compensation.
2. Failure or refusal of the Engineer to order the use of bracing or sheeting, to order better quality or larger sizes of timber; to order sheeting, bracing or shoring left-in-place; to give orders or directions on methods or placing or driving sheeting, braces or shores, shall not relieve the Contractor of any responsibility concerning the condition of excavations or his obligation under the contract.
3. Any delay, (whether caused by the Contractor or by the Owner or their agents or employees) that requires keeping an excavation open longer than would otherwise have been necessary, shall not relieve the Contractor from his obligation to properly and adequately protect the excavation from cave-ins or slipping or any of his obligations under the contract relating to injury of persons or property. In any event it shall not entitle him to any claim for extra compensation.

H. Tunnelling:

1. Tunnelling will be allowed when permission is granted by the Engineer or when it is called for in the specifications or shown on the drawings.
2. Tunnels for laying pipelines shall be of sufficient size to allow joining of pipe and compacting of backfill around them. Tunnels shall be timbered where necessary, in accordance with approved methods. All methods of tunnelling used shall be subject to approval of the Engineer. No extra payment will be made for excavation and backfill in tunnel.

I. Miscellaneous Excavation:

1. The Contractor shall do such miscellaneous excavating work as may be necessary and directed by the Engineer. Such excavation shall be subject to the same conditions and requirements specified herein for trench excavation.
2. Miscellaneous excavation shall include excavation for abandoned trenches or for any special structure outside of specified trench. Widths may not be shown on the drawings or described in specifications, where such excavation is done at direction of the Engineer.

3. When in the opinion of the Engineers an obstruction requires that the trench be excavated extra wide, such extra width shall be classified as "miscellaneous excavation" and backfill. Sloping the sides of an excavation for any reason, will not be considered as "miscellaneous excavation".

- J. Test Pits: All costs for advance test pits ordered by the Engineer or made by the contractor along line and site of work, to determine character of subsurface materials, or the exact location of utilities, shall be included in the Contractors price bid for the work.

### 3.2 BACKFILLING

- A. The Contractor shall backfill all excavations as rapidly as practicable, following inspection and approval of work by the Engineer.
- B. No part of a pipe line or other structure that needs to be located or measured, shall be filled over or around until required tests and measurements have been made and permission given by the Engineer to backfill. Any backfilling done without authorization shall be uncovered by the Contractor at his own expense.
- C. The space between pipe and sides of trench shall be backfilled by hand and thoroughly tamped with a light tamper in layers not to exceed 4 inches in thickness to a depth of at least one foot above top of pipe.
- D. The Contractor shall under no circumstances, bury or add to the backfill, excavated or broken-up asphalt. All excavated asphalt must be hauled off site.
- E. The material for backfilling within unpaved private right-of-ways from 1 foot over top of pipe to grade shall then be suitable soils as defined in Section 2.1A. The backfill material shall be evenly spread in built up layers not exceeding 8 inches for material compacted by heavy compaction equipment and 4 inches for material compacted by hand operated tampers, subject to approval of the Engineer. No stone will be allowed in refilling until earth or granular backfill has been placed at least 2 feet above pipe or structure as directed above. Backfill material placed above earth or granular backfill may contain some rock but in no case shall it exceed more than 20 percent by volume.
- F. When the opening is across or within completed State Roads, Township Roads or paved driveways, the backfill material shall be PaDOT No. 2A modified stone. The method of backfilling above 12 inches over the top of pipe to bottom of paving section shall be backfilled as specified above except that the backfill material shall consist of PaDOT No. 2A modified stone.
- G. Moisture Control

1. Where the subgrade or layer of stone material must be moisture conditioned before compaction, uniformly apply water to the layer of stone material.

2. Remove and replace, or scarify and air dry, stone materials that are too wet to permit compaction to specified density, to prevent free water appearing on the surface during or subsequent to compaction operations.

#### H. Dust Control

1. The Contractor shall make every effort to limit the amount of dust generated by construction activities. Appropriate methods and materials shall be employed and are subject to the approval of the Engineer.

### 3.3 TEMPORARY PAVING

- A. The contractor shall install temporary paving over all utility trenches in paved areas at the end of each workday. The temporary pavement shall consist of placing a 2-inch layer of cold bituminous mix in utility trenches. The contractor shall maintain, at his expense the temporary paving for a period of sixty (60) days. All depressions appearing in the temporary paving shall be promptly repaired by the contractor. If the Contractor fails to make repairs within twenty-four (24) hours after receipt of written notice from the Engineer, the Owner may backfill said depression and the cost deducted from any monies due the Contractor. In an emergency, the Owner may backfill or protect any dangerous depression wherever necessary without giving any previous notice to the Contractor and deduct the cost from any monies due or to become due the Contractor.

The Contractor shall, after thirty (30) but prior to sixty (60) days, remove the temporary paving and prepare the utility trenches for permanent paving. The cost for temporary paving will be included in the base bid prices for utility excavation, backfill and compaction.

### 3.4 MAINTENANCE

The Contractor shall maintain, at his own expense, all backfilled excavations in proper conditions as specified. All depressions appearing in backfilled excavations shall be promptly repaired by the Contractor. If the Contractor fails to make repairs within twenty-four (24) hours after receipt of written notice from the Engineer, the Owner may backfill said depression and the cost deducted from any monies due the Contractor. In an emergency, the Owner may backfill or protect any dangerous depression wherever necessary without giving previous notice to the Contractor and deduct the cost from any monies due or to become due the Contractor.

### 3.5 COMPACTION

The contractor shall be required to compact all backfill materials within Township Roads or road right-of-ways to a minimum of 95% of the materials maximum dry density as determined by ASTM D1557. For trenches within State highways, compact all backfill materials to a minimum of 100% of the materials maximum dry density.

### 3.6 TESTING

#### A. Testing Laboratory

1. Tests to determine conformance with all requirements for all Contractor secured materials proposed for use shall be performed by an independent commercial laboratory retained and compensated by the Contractor and approved by the Engineer.

2. On-site quality control testing will be performed during construction to determine conformance with plans and specifications by an independent laboratory retained and compensated by the Contractor. Frequency of sampling and testing shall be as specified in Paragraph 3.6.C this section.

3. Testing laboratory shall furnish the Contractor, Engineer and Owner with copies of all reports and certificates regarding tests and inspections of equipment, materials, and completed work.

4. Laboratory shall furnish the Engineer a sampling schedule to give the Engineer an opportunity to observe the sampling.

B. During or after the backfill operations the Engineer may take soils compactions tests in conformance with A.S.T.M. Standard Procedures or other available methods. If determined by the Engineer that any lift does not meet specified percent maximum dry density the contractor shall be required to dig test holes, as directed by the Engineer at various levels, throughout the backfill, at the contractors expense, so that additional tests may be taken. If the additional tests indicate unsatisfactory compaction the contractor shall remove all unsatisfactory backfill and recompact same to the required standards at his expense.

#### C. Frequency of Testing

1. Perform at least three (3) maximum dry density tests, in accordance with ASTM D1557, on each different type of soil or material encountered in the excavation or used for backfill.

2. Perform at least one (1) in-place density test per lift per 100 feet of trench length on the backfill material. Determine in-place density in the field in accordance with ASTM D1556, or by ASTM D2922 and ASTM D3017.

3. If it is determined by the Engineer that any lift does not meet the specified percent dry density, the Contractor shall dig test holes, as directed by the Engineer at various levels, throughout the backfill, at the Contractor's expense, so that additional tests may be taken. If the additional tests indicate unsatisfactory compaction, the Contractor shall remove all unsatisfactory backfill and recompact same to the required standards at his expense.



### 3.7 DISPOSAL OF MATERIAL

- A. Immediately after excavating trench, all material not required shall be removed and disposed of by the Contractor in such a manner and at such point or points he may select, subject to the approval of the Engineers. All roads, sidewalks, and other places on line of work shall be left free, clean and in good order at the end of each work day. All removal and cleaning-up shall be done by the Contractor without extra compensation, and, if he fails to do such work within a reasonable time, after receipt of notice, the work will be performed by the Owner, and the cost deducted out of monies due or to become due the Contractor.
- B. Remove all waste and excess materials daily, including excavated material classified as unsatisfactory soil material, trash and debris from the work area and legally dispose of it.

### 3.8 PA ACT 38 OF 1991

The Contractor shall be responsible for locating all underground structures and utilities, such as water mains, sewers, telephone and electric conduits, etc., and above ground utilities, which may be encountered during construction operations. Test holes shall be dug to determine the position of the underground structures and utilities, or the Contractor shall arrange with the Owners of such underground structures and utilities to assign a representative to mark the locations. The Contractor shall pay the cost of digging test holes and likewise he shall pay the cost of the service of the representatives of the Owners of such utilities for locating the said utilities. And the cost of determining the locations is to be included in the prices bid. The location of existing structures and utilities as shown in the contract documents is simply for the guidance of the contractor and have not been field located and, since the information is as furnished by the respective utilities, or taken from non-as-built plans, the engineer is not responsible for the accuracy of the plans in this respect.

Anyone utilizing these contract documents for construction is advised to confirm with the requirements of PA Act 38 of 1991 prior to excavation.

END OF SECTION

## SECTION 02260

### FINISH GRADING

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION OF WORK

A.This Section describes placing, compacting and rolling finish grade materials prior to landscaping work.

B.Finished grading is to be completed within 30 days after completion of the work in unpaved areas unless an extension is granted by the Engineer.

##### 1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Rough Grading - Section 02210.
- B. Structure Excavation, Backfill, and Compaction - Section 02220.
- C. Utility Excavation, Backfill, and Compaction - Section 02221.
- D. Lawns and Grasses - Section 02930.

##### 1.3 PROTECTION

A.Prevent damage to existing fencing, trees, landscaping, natural features, bench marks, pavement, utility lines and other existing site features. Correct damage at no cost to the Owner.

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS

A.Onsite Topsoil: Onsite soil material from the top 6 inches of ground surface, as available in stockpiles, and as approved by Engineer.

B.Offsite Topsoil: If on-site topsoil is insufficient in quantity to provide specified thickness, provide topsoil from approved off-site sources as required to complete the work. Off-site topsoil shall meet the following minimum requirements.

1. Topsoil shall be fertile, friable, well drained, pH range of 6.0 to 6.5, free of sub-soil, toxic substances harmful to plant growth without clay lumps, stones, roots or debris. Analysis of content shall be as follows:

Sand	- 35% to 40%
Clay	- 15% to 20%
Organic Matter	- 2.5%
Silt	- Balance

2. Test off-site topsoil by a soils testing laboratory retained and compensated by the Contractor and approved by the engineer and submit copy of test report for approval by the engineer.

## PART 3 - EXECUTION

### 3.1 SUBSOIL PREPARATION

- A. Rough grade subsoil systematically to allow for a maximum amount of natural settlement and compaction. Eliminate uneven areas and low spots. Remove debris, roots, branches, stones, etc. in excess of 2 inches in size. Remove subsoil which has been contaminated with petroleum products, or other toxic substances.
- B. Cut out areas, to sub-grade elevation, which are to receive stabilizing base for paving, sidewalks, and planting beds.
- C. Bring subsoil to required levels, profiles and contours. Make changes in grade gradually. Blend slopes into level areas.
- D. Slope grade away from building minimum 2 percent, unless indicated otherwise on drawings.
- E. Cultivate subgrade to a depth of 6 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.
- F. Compact subsoil as specified.
  1. General: Control soil compaction during construction providing minimum percentage of density specified for each area classification.
  2. Control soil compaction during construction for compliance with the percentage of maximum dry density specified in accordance with ASTM D 1557.
  3. Place fill in approximately horizontal lifts with a loose thickness of not more than eight (8) inches for material compacted by heavy compaction equipment four (4) inches for material compacted by hand operated tampers.
  4. Percentage of Maximum Density Requirements: All fill and backfill, shall be compacted in maximum 8-inch thick lifts to a minimum of 95 percent of maximum dry density. During placement and compaction, the moisture content of fill, backfill and structural backfill material shall be not more than 2 percent above or below the optimum moisture content. Non-structural compacted fill (lawns and unpaved areas) shall be compacted to a minimum of 92 percent of maximum dry density.
  5. The moisture content of the fill materials shall be adjusted, if necessary, by aeration or sprinkling, so as to be within plus or minus two percentage points of the optimum moisture content determined in the laboratory.
  6. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

### 3.2 PLACING TOPSOIL

- A. Place topsoil in areas where seeding and sodding is to be performed. Place to the following minimum depths, up to finished grade elevations.
  - 1. 6 inches for seeded areas.
  - 2. 6 inches for sodded areas.
- B. Use topsoil in relatively dry state. Place during dry weather.
- C. Fine grade topsoil eliminating rough and low areas to ensure positive drainage. Maintain levels, profiles and contours of finish grades. Unless indicated otherwise on the drawings, the finish grades shall conform to the grades that exist prior to construction.
- D. Remove stone larger than half an inch, roots, grass, weeds, debris, and other foreign material while spreading.
- E. Manually spread topsoil around trees, plants, and building to prevent damage which may be caused by grading equipment.
- F. Lightly compact or roll placed topsoil.

### 3.3 SURPLUS MATERIAL

- A. Leave stockpile areas and entire job site clean and raked.

END OF SECTION

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SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 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.

1.2 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.3 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.

1.4 INFORMATIONAL SUBMITTALS

- A. 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.

- B. 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 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 stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

- C. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.

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- D. Predemolition Photographs or Video: 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.
- F. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.
- B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

#### 1.6 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

#### 1.7 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, coordinate with Owner for Owner removal of items prior to commencement of demolition Work.
- 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. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

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1.8 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

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 ANSI/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 record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
  - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.
  - 1. Comply with requirements specified in Section 013233 "Photographic Documentation."
  - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.

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### 3.2 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 indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. 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.
  - 2. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated 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.
    - 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.
- C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

### 3.3 PREPARATION

- A. Temporary Shoring: 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.

### 3.4 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



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- power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. 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 fire watch and portable fire-suppression devices during flame-cutting operations.
  5. Maintain adequate ventilation when using cutting torches.
  6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
  7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
  8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  9. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."

B. 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 as designated by Owner or as indicated on Drawings.
5. Protect items from damage during transport and storage.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."
- E. 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 Insert 075323 "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing" for new roofing requirements.
  1. Remove existing roof membrane, flashings, copings, and roof accessories.
  2. Remove existing roofing system down to substrate.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

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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 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

### 3.7 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**

SECTION 02600  
STORM SEWER STRUCTURES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This work consists of furnishing and installing storm sewer manholes, inlets and end sections of the type specified and depicted on the plans, at the depth indicated. This work includes but is not limited to: replacement of existing inlets and/or manholes or the installation of new inlets and/or manholes of the type specified at the locations indicated on the plans.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Utility Excavation, Backfill and Compaction - Section 02221
- B. Storm Sewer Pipe - Section 334100

1.3 REFERENCE STANDARDS

- A. Pennsylvania Department of Transportation (PennDOT) Publication No. 72, latest edition.
- B. Pennsylvania Department of Transportation (PennDOT) Publication No. 408, latest edition.
- C. American Society for Testing of Materials (ASTM)
  - A 48 Standard Specifications for Gray Iron Castings
  - C 478 Standard Specification for Precast Reinforced Concrete Manhole Sections
  - C 913 Standard Specifications for Precast Concrete Water and Wastewater Structures
  - C 923 Standard Specification for Resilient Connectors Between Concrete Manhole Structures and Pipe

1.4 SUBMITTALS

- A. Before any work is started, submit Certificates of conformance for all precast concrete structures to the Engineer, in triplicate, proving conformance with specifications. All precast concrete components shall be covered by a guarantee certificate furnished by the Contractor and signed by an officer of the precast manufacturer.

- B. For modified or special inlet designs which are not detailed on the plans or in the specifications the Contractor shall submit shop drawings to the Engineer for review. Special inlet designs must be approved by the Engineer prior to use.
- C. Submit manufacturer's data for the following manufactured inlet components:
  - 1. Frame and cover
  - 2. Other special or unique components

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Concrete:
  - 1. Unless otherwise indicated, concrete shall be in accordance with Section 704 of PennDOT Publication 408, current edition for Class AA cement concrete with a minimum 28-day compressive strength of 3,750 p.s.i. and an entrained air content of 6%.
- B. Brick and Mortar:
  - 1. Brick: Conform to ASTM C 32 Grade SM.
  - 2. Mortar:
    - a. Aggregate: ASTM C 144.
    - b. Portland Cement: ASTM C 150, Type I, of natural color - or white to produce required color.
    - c. Hydrated Lime: ASTM C 207, Type S.
    - d. Water: Clean and potable.
  - 3. Mortar Applications: One part portland cement and two parts sand with hydrated lime added not to exceed 20% of the "cement by weight".
- C. Mortar:
  - 1. Use mortar meeting the requirements of ASTM C 270 entitled Mortar for Unit Masonry. Use Type M mortar consisting of: (1) part portland cement; (1/2) part hydrated lime; and fine aggregated, measured in a damp, loose condition in an amount not less than (2-1/4) or more than (3) times the sum of the volumes of the cement and lime used.
  - 2. If required use the type of chemically resistant mortar indicated.
- D. Precast Storm Sewer Manholes:

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1. General: Provide precast reinforced concrete sewer manholes as indicated and complying with ASTM C478.
2. The sections shall conform to the requirements of "Specifications for Precast Reinforced Concrete Manhole Sections" (ASTM C 478), except that the joints shall be sealed with a Preformed Plastic Gasket that meets or exceeds all requirements of Fed. Spec. SS-S-00210, "Sealing Compound Preformed Plastic for Pipe Joints", Type 1, Rope Form.
3. The Sealing Compound shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler, and shall contain no solvents, irritating fumes or obnoxious odors. The compound shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength. It shall be supplied in extruded rope-form or suitable cross-section and of such sizes as to seal the joint space when the sections are set in place. The sealing compound shall be protected by a suitable removable two-piece wrapper. The two-piece wrapper shall be so designed that one-half may be removed longitudinally without disturbing the other half to facilitate application of the sealing compound.
4. The top of base walls, the ends of reinforced concrete risers and the bottom ends of precast tops shall be so formed that when risers and tops are assembled with the base, they will make a continuous manhole. Joints shall be of such design as will permit effective joining and placement without irregularities in the interior wall surface of the manhole.
5. Manhole barrels shall consist of riser and top sections with a minimum wall thickness of 5 inches. The top section shall be an eccentric conical section with thickened upper walls with the smallest inside diameter equal to 24 inches, to receive the manhole frame and cover. No more than 2 lift holes shall be cast in each barrel or top section.
6. Manhole riser and top sections shall be designed, manufactured, tested, finished and marked in accordance with this specification and ASTM C 478.
7. Top: Precast concrete, of concentric cone, eccentric cone, or flat slab top type, as indicated.
8. Base: Precast concrete, with base riser section and separate base slab, or base riser section with integral floor, as indicated.
9. Steps: Aluminum for manhole steps shall be manufactured and tested in accordance with ASTM B 221 Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes, Alloy 6061 T6. Embedded ends of aluminum steps shall have 2 coats of bitumastic. Steps shall be located a minimum of 6 inches from the ends of riser and top sections.
10. Pipe Connectors: Resilient complying with ASTM C 923.

E. Precast Concrete Inlet Sections:

1. Use precast reinforced concrete inlet sections, including grade rings, top units riser sections and base sections, complying with ASTM C 913 Standard Specifications for Precast Concrete Water and Wastewater Structures.
2. Use precast reinforced concrete inlets having joints made watertight by applying an approved bitumen - type sealing compound to the joint.

3. Provide inlet boxes of the size and type indicated.
- F. Precast Concrete End Sections:
1. Provide precast reinforced concrete end sections of the type and size indicated.
  2. All end sections shall be in accordance with PennDOT Publication No. 72, latest edition.
- G. Connections to Inlets and Manholes
1. Unless otherwise indicated seal joints between pipes and structures with non-shrink, non-metallic mortar. The mortar shall not contain gas-forming agents; the volume change shall be 0 or shall increase slightly; the time of set shall be a minimum of 45 minutes and the 28 day compressive strength shall be 6000 psi.
  2. If indicated, use resilient connectors to insert pipe into precast reinforced concrete inlets. Resilient connectors shall meet the requirements of ASTM C 923 Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipe and must be approved by the Engineer prior to use.
- H. Reinforcement:
1. Reinforcing bars shall conform to ASTM A 615, Standard Specifications for Deformed Billet-Steel Concrete Reinforcement.
  2. Welded wire fabric shall conform to ASTM A 185, Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement.
- I. Inlet/Manhole Steps
1. If the depth of Inlet or Manhole exceeds four (4) feet, steps will be required. The materials for steps shall be as follows:
    - a. Aluminum for manhole steps shall be manufactured and tested in accordance with ASTM B 221 Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes, Alloy 6061 T6. Embedded ends of aluminum steps shall have 2 coats of bitumastic.
- J. Inlet Frame and Grate:
1. Provide inlet frames and grates of the type and size indicated including hardware, if specified.
  2. Inlet frames and grates shall be gray iron or structural steel. Gray iron grates and steel grates must be interchangeable.
  3. Inlet frames and grates made of Class 30B gray iron shall be tested in accordance with ASTM A 48 Standard Specification for Gray Iron Castings. Cast name of the foundry and the heat and lot number into the frame and into the top of the grate.

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4. Use steel fabricated grates and frames conforming to ASTM A 36 Standard Specification for Structural Steel.
5. Coat structural steel grates with bituminous paint in the shop or in the field, prior to placement. Coat structural steel frames with bituminous paint at the time of placement in the concrete inlet top. Cover frames and grates completely with no pin holes or voids.
6. Ground smooth all projections and roughness. The bearing surface of the frame and grate shall not rock or jam.
7. Provide bicycle safe grates for all inlets, unless indicated otherwise.

K. Manhole Frame and Cover:

1. Manhole frames and cover shall be of the type and size specified and shall include bolts, gaskets and hardware, if indicated.
2. Manhole frames and covers shall be made of Class 35B gray iron which is tested in accordance with ASTM A 48 Standard Specification for Gray Iron Castings. The name of the foundry and the heat and lot number shall be cast into the frame and into the exterior side of the cover.
3. Manhole frames and covers shall be thoroughly cleaned. All projections and roughness shall be ground smooth. The bearing surfaces of the frame and cover shall not rock or jam.
4. Castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion or other defects. They shall be smooth and well-cleaned by shotblasting or by some other approved method. They shall be coated with asphalt paint which shall result in a smooth casting, tough and tenacious when cold, not tacky and not brittle. Materials shall conform to ASTM A 48 C1.30. The riser and cone sections shall be adequately reinforced in accordance with ASTM C 478 Specifications.

### PART 3 - EXECUTION

#### 3.1 EXCAVATION, SUBGRADE PREPARATION AND BACKFILL

A. Excavation:

1. Excavation includes the removal of material of whatever nature encountered including existing structures within the limits of excavation, from the top of existing grade, or from the pavement subgrade line when existing paving is to be removed, to the inlet subgrade.
2. When constructing inlets or manholes in conjunction with existing pipes excavate in a safe manner down to the subgrade, and in a manner that will not disturb the existing pipes.
3. The existing frame and grate, or other salvageable appurtenances become the property of the Contractor unless the inspector gives written notice to the contractor that these items will be reclaimed by the Owner. The written notice will be issued prior to the contractor beginning the reconstruction work and will

specify the items to be reclaimed and the location to which the Contractor shall deliver the reclaimed items.

Carefully remove items to be reclaimed by the Owner and clean any excess concrete or mortar shall be cleaned from the surface prior to delivery to the Owner.

4. Use sheathing and shoring in the excavation, as required and necessary. It shall be left in place and shall be of sufficient strength to withstand all external pressures.

B. Subgrade Preparation:

1. Surface grade fill material or subgrade beneath the structure to provide a uniform, firm and continuous support. Density fill material beneath the structure.
2. No structure shall be placed upon a foundation into which frost has penetrated, nor at any time when the Engineer deems that there is a danger of formation of ice or penetration of frost at the bottom of Excavation. Where the foundation is unsuitable, as determined by the Engineer, over-excavate the pit to a suitable depth and place a stone or gravel foundation and tamped to form an acceptable bed for the structure.
3. Upon completion of subgrading operations, place, level and tamp the AASHTO #57 stone bed, eighteen (18) inches thick.

C. Backfill:

1. Backfill excavated spaces around the structure, with acceptable material upon approval by the Engineer.
2. Satisfactorily dispose of unsuitable and surplus material.
3. Additional requirements for backfill and compaction are as specified herein for the appropriate conditions.
4. Allow cast-in-place or brick inlets to cure sufficiently prior to backfill.

3.2 INLET CONSTRUCTION

- A. Provide precast reinforced concrete sections with handling holes positioned so that the section remains balanced during setting. After setting the handling holes shall be sealed watertight, using non-shrink, non-metallic type mortar. Furnish precast concrete sections in lengths of 1, 2, 3, or 4 feet to suit any depth to within one foot, however, the number of joints shall be minimized.

When installing a 2 piece catch basin, remove all foreign materials, such as dirt, mud and stones from the joint surfaces. Apply a bitumen-type sealing compound to seal the joint.

- B. The flow channel through inlets should be made to conform in shape and slope to that of the sewers.



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- C. Pipes shall be set flush with the inside face of the walls.
- D. If the depth of the inlet exceeds four (4) feet, place steps in an appropriate wall, spaced 12 inches O.C. vertically from top to bottom
- E. Set frames and grade adjustment rings (if required) in full mortar beds.

### 3.3 MANHOLE CONSTRUCTION

- A. The minimum diameter of manholes shall be 48 inches. A minimum access diameter of 24 inches shall be provided.
- B. The flow channel through manholes should be made to conform in shape and slope to that of the sewers. The flow channel shall be constructed to 2/3 the depth of the largest pipe in the manhole.
- C. Pipes shall be set in manholes with the pipe end flush with the inside face of the manhole.
- D. If the depth of the manhole exceeds four (4) feet steps will be required and shall be placed in an appropriate wall and spaced 12 inches O.C. vertically from top to bottom of manhole.
- E. Where the manhole depth from grade to invert is less than 6'-0" deep, a flat size (6) inches thick reinforced concrete slab with eccentric opening shall be used upon approval of the engineer.
- F. Set frames and grade adjustment rings (if required) in full mortar beds.
- G. Precast reinforced concrete risers and cone section shall be provided with handling holes positioned so that the section remains balanced during setting. After setting the handling holes shall be sealed watertight, using non-shrink, non-metallic type mortar. The entire exterior surface shall be provided with a shop applied bituminous coating equal to Pennsbury Pennoxty Tar 32-B-4. Riser sections shall be furnished in lengths of 1, 2, 3 or 4 feet to suit any depth to within one foot, however, the number of joints shall be minimized.

### 3.4 TESTING AND ACCEPTANCE

- A. The Contractor shall cooperate and furnish all equipment, labor, and assistance necessary to perform testing required by the Engineers unless otherwise specified.
- B. If required by the Engineer a manhole test shall be performed to determine the watertightness of the manhole.
- C. All defects found shall be repaired or replaced by the Contractor, at his expense, to the full satisfaction of the Engineer prior to acceptance.

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END OF SECTION 02600

## SECTION 02615

### DOMESTIC WATER PIPE, MATERIALS, VALVES, APPURTENANCES AND TESTING

#### PART I GENERAL

##### 1.1 WORK INCLUDED

A. Work included shall consist of water main distribution piping, wet tap, gate valves, and all necessary or required fittings and appurtenances.

B. Provide all pipe, pipe fittings, pipe flanges, adaptors and connections; joint materials including gaskets, nuts, bolts and washers; pipe supports; miscellaneous small diameter piping, valves, fittings, and accessories; and all other items required to perform the work and as required for a complete and operational installation as specified herein.

##### 1.2 WORK SPECIFIED ELSEWHERE

A. Division 1 - General Requirements

B. Section 02221 - Utility Excavation, Backfill and Compaction

C. Section 02320 - Utility Casings

##### 1.3 REFERENCE STANDARDS

A. Plumbing code compliance: comply with applicable portions of National Standard Plumbing Code pertaining to schedule and installation of potable water system materials and products.

B. American Society for Testing and Materials

A 48 - Gray Iron Castings.

A 126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

A 194 - Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service.

A 197 - Cupola Malleable Iron.

A 307 - Carbon Steel Externally and Internally Threaded Standard Fasteners.

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Quality. A 506 - Steel Sheet and Strip, Alloy, Hot-Rolled and Cold-Rolled, Regular

A 573 - Structural Carbon Steel Plates of Improved Toughness.

B 61 - Steam/Valve Castings

B 62 - Composition Bronze or Ounce Metal Casting.

B 88 - Seamless Copper Water Tube.

D 429 - Tests for Rubber Property - Adhesion to Rigid Substrates.

C. American National Standards Institute (ANSI)

B1 - Pipe Threads.

B16- Pipe Flanges and Flanged Fittings.

B18- Bolts and Nuts.

D. American Water Works Association (AWWA) Compliance:

Other Liquids. C 104 - Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.

C 110 - Ductile Iron and Gray Iron Fittings, 3 in. through 48 in. for Water and

Fittings. C 111 - Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and

Molds for water and other liquids. C 151 - Ductile Iron Pipe, Centrifugally Cast in Metal Molds and Sand-Lined

C 509 - Resilient-Seated Gate Valves for Water Systems.

C 550 - Protective Interior Coatings for Valves and Hydrants.

C 600 - Installation of Ductile-Iron Water Mains and their Appurtenances.

C 651 - Standard for Disinfecting Water Mains.

C 800 - Underground Service Line Valves and Fittings.

E. United States Department of Agriculture (USDA).

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F. Pennsylvania Department of Transportation (PennDOT) Publication 408, "Specifications", current edition.

#### 1.4 SUBMITTALS

A. Submit shop drawings and product data in accordance with the provisions of these Contract documents.

B. Before any work is started, Certificates of Conformance for all materials shall be submitted, in accordance with Section 01340, assuring conformance with these specifications. All pipe and appurtenances specified herein shall be covered by a guarantee certificate furnished by the Contractor and signed by an officer of the respective manufacturer.

C. Record Drawings: At project closeout, submit record drawings of installed water system piping and products, in accordance with requirements of Division 1.

D. Maintenance Data: Submit maintenance data and parts lists for water system materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Division 1.

E. Restrained joint piping calculations, details, pressure rating and respective pipe lengths from approved manufacturer.

#### 1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Obtain materials from firms regularly engaged in manufacture of water system's products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Retain a firm with at least 3 years of successful installation experience on projects with water main and fitting installation work similar to that required for project.

### PART 2 MATERIALS

#### 2.1 ACCEPTABLE MANUFACTURERS

A. Specifications cite acceptable manufacturers. Alternative manufacturers meeting the performance specification may be accepted at the Engineer's discretion. All materials and products shall be in accordance with ASTM, ANSI, and AWWA sections identified herein.

#### 2.2 DUCTILE IRON PIPE

A. Manufacturer: Pipe and fittings shall be as manufactured by American Cast Iron Pipe Co., U.S. Pipe, Griffin Pipe, Clow Corporation, or approved equal.

B. Application: Ductile iron pipe and fittings shall be used for all water distribution mains and transmission mains, where indicated.

C. All buried ductile iron shall conform to AWWA C151. Pipe shall be Class 52 or Class 56 as indicated on drawings, with mechanical joints or push on joints conforming to AWWA C111.

D. Joint Restraint

1. Thrust blocks or restrained joint fittings shall be required at all points of thrust.
2. Thrust blocks and restrained joint fittings are both required within the railroad right-of-way.
3. Restrained joint shall be restrained mechanical or push-on joints. Mechanical joint retainer glands are not acceptable.

E. Fittings

1. Fittings for buried ductile iron pipe shall be mechanical joint, conforming to AWWA C110 and AWWA C111 Class 350. Fittings shall be furnished suitable for use with the type of pipe specified herein.

F. Coatings and Linings

1. All buried ductile iron piping and fittings shall have standard bituminous coating applied to exterior surfaces. Interior surfaces of all ductile iron pipe and fittings shall have a double cement-mortar lining conforming to AWWA C104, seal coated inside.

## 2.3 COPPER SERVICE

- A. Copper Services shall be installed as directed by the Engineer.
- B. Copper water service tube shall be ASTM B 88, Type "K" soft for buried service and rated for 200 psi (minimum) test pressure.
- C. Fittings for copper tubing shall be wrought copper solder and type PWE ANSI B16.29 as manufactured by Nibco, Mueller Brass Co., or the Chase Brass Co., or approved equal and shall be made from alloy of pure commercial copper and red bronze mill products.
- D. Packed joint compression type connections shall be required for buried piping. Joints in copper piping shall be made with non-corrosive paste flux and solid string or wire solder. Cored solder will not be permitted. Composite of solder shall be 95% tin and 5% antimonial. No buried solder joints will be permitted.
- E. Each length of pipe shall have the trademark of the company manufacturing same plainly stamped in the metal and be guaranteed by the manufacturer not to split or be otherwise defective.
- F. No buried joint shall be permitted between the curb stop and meter.

## 2.4 GASKETS AND BOLTING MATERIALS

- A. Provide all gaskets, bolts, lubricant, and other accessories required to install pipe, fittings and equipment complete and ready for service.
- B. All bolting shall conform to the appropriate standards: ASTM A307 Grade B for bolts and ASTM A194 Grade 2 for nuts. All bolting shall be cadmium plated, except for submerged conditions where stainless steel shall be provided.
- C. Dimensions shall conform to ANSI B18.2.1 for bolts and ANSI B18.2.2 for nuts. Threading shall conform to ANSI B1.1 Class 2A fit for bolts and Class 2B fit for nuts.
- D. Bolts shall extend completely through the nuts and may have reduced shanks of a diameter not less than the diameter at the root of threads.
- E. Washers shall be steel, cadmium plated, to fit within the bolt facing on the flange. Stainless steel washers shall be used for submerged conditions.
- F. Gaskets shall be 1/8 inch thick cloth inserted synthetic rubber full face gaskets with holes punched for flanges conforming to AWWA C111. Gaskets for ductile iron flanged pipe and fittings 12 inch and smaller shall have "nominal" inside diameters, not the larger inside diameters per ANSI B16.21.
- G. Gaskets and bolts for other than flanged joints shall be as required for mechanical joints and/or push-on joints as applicable, in accordance with AWWA requirements.

## 2.5 GATE VALVES 3 INCHES TO 12 INCHES

- A. Valves shall conform to AWWA C509. Valves shall be mechanical joint, as required or as indicated. Valves shall be rated per 200 psi working pressure, resilient seated type, bonded encapsulated double sealing disc, high strength cast iron body, double "O" ring at stem with reinforced flanged, corrosion resistant threaded bronze stem with bronze or plated steel stem nut. Valves shall be of the non-rising stem type (NRS) for use with a valve box as manufactured by A.P. Smith, American Darling, the Waterous Company, U.S. Pipe, or approved equal.
- B. Double sealing disc (gate) shall be solid heavy duty cast iron coated with corrosion resistant permanently bonded synthetic elastomer or permanently bonded vulcanized synthetic rubber. Coatings shall meet or exceed ASTM D-429.
- C. Encapsulated wedge and valve sealing shall be bubble tight in both directions with zero leakage. Gate shall be made with low friction, non-abrasive thermoplastic inserts in order to minimize wear on the internal coating of the valve body.
- D. Wedge travel shall be smooth up and down and shall not abrade the protective coating.

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E. Valve body and bonnet shall be fusion bonded epoxy, coated inside and outside to a minimum thickness of 8 mils. All other ferrous metal surfaces shall be provided with a permanent fusion bonded epoxy coating and no exceptions to this shall be permitted. All protective coatings shall conform to AWWA C550 latest revision.

F. Waterway area shall be unobstructed and valves shall be capable of passing a full size shell cutter. Valve interior shall be of very smooth contours, free of ledges, pockets or other areas which can collect debris or sediment.

G. Stem seal design shall allow replacement of "O" ring seals while valve is in any position of service. Stem shall also include thrust washers.

H. Valves shall be factory tested. Valves shall be tested in the "Disc Up" position at 400 psi, and there shall be no leakage at joints or connections.

I. All valves shall open counterclockwise. Buried valves shall be furnished with a 2 inch square operating nut. Valve extension will be required for a valve in excess of six (6) feet deep. Non-buried valves shall be furnished with a handwheel operator. Valves shall have mechanical joint, ends as required or indicated. Mechanical joint end connections shall conform to AWWA C111.

## 2.6 SLEEVES AND COUPLINGS

### A. Sleeve Couplings

1. Manufacturer: Sleeve couplings shall be Smith-Blair Type 431, by Rockwell International; Dresser Style 53, by Dresser Industries, Inc.; Ford Style FC1, by Ford Meter Box Company, Inc., or approved equal.
2. Application: Shall be provided for joining buried ductile iron pipe where approved by the Engineer.
3. Sleeves for buried piping shall be gray iron ASTM A-126 Class B.

### B. Flanged Coupling Adapters

1. Manufacturer: Flanged coupling adapters shall be Smith-Blair Type 912, by Rockwell International; Dresser Style 127, by Dresser Industries, Inc.; approved type by Ford Meter Box Company, Inc., or approved equal.
2. Application: Shall be provided for joining exposed interior ductile iron piping as required and where indicated.

C. The use of couplings for buried piping shall be held to a minimum. They should only be used to make field closures necessitated by the pipe laying sequence.

D. Furnish joint restraint where required to withstand internal pipeline forces and hydrostatic test pressures. Harnesses shall consist of lugs or clamps securely fastened to opposite joint elements with tie rods between opposing lugs. Mechanical joint retainer glands shall not be used where joint restraint is required.



## 2.7 CORPORATION STOPS AND TAPPING SADDLES

### A. Corporation Stops

1. Application: Corporation stops shall be tapped into the ductile iron distribution mains at each service connection 2 inches and smaller (3/4 inch minimum) and where indicated.
2. The inlet threads shall be male iron pipe thread, as specified. The outlet threads shall be increasing copper tube and shall be provided with Pack Joint compression nuts. Corporation Stops shall conform to AWWA Standard C800 as regard to thread types and diameters.
3. All castings shall be certified water works red brass composed of 85% copper and 5% each of tin, lead, and zinc conforming to AWWA C800 and ASTM B62. Each stop shall be watertight and individually tested for leaks. The valve body shall be cast with square shoulders to provide wrench flats. All threads shall be coated or capped for protection against damage during shipment or handling.
4. The outlet compression coupling shall be for CTS/Type "K" tubing, specified elsewhere in this Section. A beveled Buna-N rubber gasket shall provide a watertight seal, while the pack joint nut shall be provided with a split clamping device with grooves activated. Installation shall be suitable for a normal working pressure of 150 psig and a hydrostatic test pressure of 200 psig.

### B. Tapping Saddles

1. Application: Tapping saddles shall be used when tapping corporation stops into 3- and 4- inch ductile iron Class 52 distribution mains.
2. Tapping saddles shall be compatible for use with the corporation stops furnished.
3. Tapping saddles shall be the following sizes. Nominal

<u>Pipe Size</u>	<u>Pipe O.D.</u>	<u>Tap Size</u>
3"	3.96"	1"
4"	4.80"	1"
4"	4.80"	1¼"

## 2.8 VALVE BOXES

- A. Manufacturer: Valve boxes shall be as manufactured by Bingham and Taylor, Tyler Pipe, or approved equal.
- B. Provide valve box for all buried valves.
- C. Shall be two-piece, cast iron screw type with 5-1/4 inch shaft.

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D. Boxes shall be of adequate extension for the depth required and have a base suitable to the particular valve.

E. Cover shall be cast iron drop type and marked "WATER".

## 2.9 CURB STOPS AND CURB BOXES

### A. Curb Stops

1. Application: Curb stops shall be installed between the corporation stop and the building as indicated.
2. Curb stops shall be Mueller 300 Ball Curb Valve, or approved equal.
3. Curb stops shall be of the ball valve type. Valves shall be cast of red brass containing 85% copper, and 5% each of tin, lead, and zinc conforming to the AWWA C800 and ASTM B62. The ball shall be fluorocarbon coated brass and shall be held securely in place. Fluorocarbon shall meet USDA standards. Valves shall be watertight against flow in either direction. The stem that turns the ball shall exert no other force on it except to open or close the ball and shall be held securely in place by means of a bronze ring.
4. The seal around the stem shall consist of "O" rings. Rubber parts shall be Buna-N.
5. End connections shall be pack joint compression type connections for CTS/Type "K" tubing. The valve shall turn easily and shall be of quality construction throughout.
6. Curb stops shall be suitable for a normal working pressure of 150 psig and a hydrostatic test pressure of 200 psig.
7. Curb stops shall be the following sizes.

Service Line	Curb stop
<u>Size</u>	<u>Size</u>
2"	2"

### B. Curb Boxes

1. Application: Shall be provided for each curb stop.
2. Shall be Mueller extension type with arch pattern base and stationary rod, or approved equal.
3. Shall be compatible with the curb stop furnished.
4. Lid shall be Mueller one piece cast iron lid type, or approved equal, and shall be labeled "WATER".
5. An enlarged base shall be provided for all curb stops larger than 1-inch. Base shall be cast iron.

6. Upper section shall be steel and shall have a diameter of 1-1/4 inch.
7. Curb boxes placed in concrete shall be installed with a cast iron curb box sleeve.
8. A shut-off rod shall be furnished for each box.
9. Boxes shall be heavily coated with an asphalt-base paint.
10. The Contractor shall furnish the Authority with three (3) shut-off rods to operate the curb stops. The shut-off rods shall have by a stainless steel screw. This clamping device shall provide mechanical pullout and hydraulic blow out protection.

## 2.10 HYDRANTS

### A. Hydrants on Mains 6 Inches and Larger lengths as required but not less than 7'-0".

1. Manufacturer: Hydrants shall be from a manufacturer approved by the Owner and the local fire department.
2. Application: Hydrants shall be installed where indicated for fire fighting requirements and for the purpose of flushing the mains.
3. The contractor shall furnish and install hydrants as shown on the drawings. Installation shall be complete with all appurtenances, ready for operation.
4. Shoe size shall be 6-inch for connection to the mains. Provide mechanical joint shoe.
5. All hydrants furnished shall be manufactured in accordance with AWWA C502 and shall be of the compression type with hydrant valve opening against the pressure and closing with the pressure. Hydrostatic test pressure shall be 500 psig with a normal working pressure of 250 psig
6. Hydrants shall be rated for 250 psi operating pressure and tested at 500 psi to assure proper assembly and operation and detect any imperfections. All iron parts as designated in section 3.1.2. of AWWA C502-85 shall be ductile iron. Gray iron is not permitted, except for those parts which are designated to break upon traffic impact.
7. Nozzles shall have two 2½" hoses 180 degrees apart and one 4½" pumper. All nozzles shall be at the same elevation. Nozzle threads shall be National Standard Fire Hose Coupling Screw Thread as described in Appendix A of AWWA C502, unless otherwise specified. Nozzle caps shall have nut configuration the same as the hydrant operating nut. Nozzles shall be reverse threaded into the upper barrel and mechanically locked in place.

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8. Hydrant main valve shall be 5¼" minimum, and shall be of the full compression design, opening against and closing with the pressure. The main valve seat ring shall thread onto a bronze sub-seat and all the gaskets sealing the seat ring shall bear on a bronze seating surface. The seat ring threads shall not serve as a pressure seal. The entire valve and rod assembly shall be removable by use of a small light-weight seat removal wrench.
9. There shall be two drain valves which allow complete drainage of all residual water in the hydrant. The circumferential drain passage inside the hydrant shall be bronze on all surfaces.
10. All exterior bolting and fasteners below the groundline shall be stainless steel. Plated steel bolts and nuts are not acceptable. This also applies to extension sections.
11. Hydrant shall be breakaway type, with frangible barrel and rod couplings designed to break upon traffic impact to prevent further damage to the hydrant and connecting piping. The barrel coupling shall allow the upper section to be rotated to any desired position. Couplings which employ lugs, keeper devices, frangible bolts, or a breakaway barrel are not acceptable.
12. Hydrant operating nut shall be ductile iron and shall be pentagonal in shape, 1½" point to flat (AWWA standard). The operating nut shall also function as a weather shield. Hydrant shall open left (counterclockwise).
13. The operating mechanisms shall utilize two "O" ring seals between the revolving nut and bronze-sheathed upper section of the valve rod. The top of the rod shall also be fitted with a travel stop nut to limit downward travel of the rod. All-weather grease shall be used to provide permanent lubrication. A thermoplastic thrust washer shall be used to reduce friction in the thrust collar while opening the hydrant.
14. The hydrant inlet shall be Mechanical Joint. Joint restraint shall be accomplished by use of Mechanical Joint gripper glands.
15. Hydrants shall be painted silver.
16. Manufacturer shall certify that hydrants furnished meet this specification.

## 2.11 ACCESSORIES

A. Anchorages: Provide anchorages for tees, wyes, crosses, plugs, caps, bends and valves. After installation, apply full coat of asphalt or other approved corrosion- retarding material to surfaces of ferrous anchorages.

1. Clamps, Straps, and Washers: Steel, ASTM A506.
2. Rods: Steel, ASTM A575.
3. Rod Couplings: Malleable-iron, ASTM A197.
4. Bolts: Steel, ASTM A307.

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5. Cast-Iron Washers: Gray-iron, ASTM A126.
6. Thrust Blocks: Concrete, minimum 28 day compressive strength of 3000 psi, in accordance with the Water Details.
7. Crushed Stone: AASHTO No. 57 or PennDOT No. 2A coarse aggregate in accordance with the requirements of PennDOT Specifications Section 703.2.

## 2.12 DISINFECTANT

- A. Disinfectant shall be free chlorine liquid, powder, tablet, or gas.

## PART 3 EXECUTION

### 3.1 PIPE LAYING

- A. Pipe laying shall conform to NFPA 24 and AWWA C600 with excavation and backfill in accordance with Section 02221. Pipe laying shall be accomplished only in the presence of the Engineer or their authorized representative. Adequate and suitable equipment and appliances for safe and convenient handling and laying of pipes shall be used.
- B. Prior to being lowered into the trench, each pipe and fitting shall be carefully inspected and those not meeting specifications or are otherwise defective shall be rejected and removed from the project.
- C. Pipes shall be thoroughly cleaned before they are laid and shall be kept clean until acceptance of complete work. Open ends shall be provided with a stopper carefully fitted so as to keep dirt and other substances from entering the main. Unless approved otherwise by the Engineer, a stopper shall be kept in the end of the line when work is not in progress.
- D. Pipe shall be laid so that when completed, the interior bore will conform accurately to grades and alignment indicated by the plans or directed by the Engineer.
- E. Before joints are made, each pipe shall be well bedded and no pipe shall be brought into position until the preceding length has been thoroughly secured in place. Coupling or bell holes shall be dug sufficiently large to insure the making of a proper joint. All joints shall be made in strict conformance with the manufacturer's instructions.
- F. The excavation into which the pipe is being laid shall be kept free from water and no joints shall be made under water. Water shall not be allowed to rise in excavation until joint is complete. Care shall be used to secure watertightness and to prevent damage to joints during backfilling. All pipe joints shall be watertight within allowances established by these specifications.
- G. No pipe shall be laid upon a foundation into which frost has penetrated, nor at any time when the Engineer shall deem that there is a danger of formation of ice or penetration of frost at the bottom of excavation. Where the foundation is unstable or consists of rock, a stone or gravel foundation, at least six (6) inches thick, shall be placed and tamped to form an acceptable bed for the pipe.

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H. Suitable tools and appliances for safe and convenient handling and laying of pipe and fittings shall be used. Extra care shall be exercised to prevent damage to pipe lining and coating.

I. At the end of each day the end of pipe line shall be tightly closed with an expansion stopper to prevent dirt or other substances from entering the line.

J. Buried piping which passes above or beneath storm or sanitary sewer piping, water mains, or other utilities shall have a vertical separation of at least 18 inches.

K. Buried piping which passes beneath streams shall have a minimum depth of cover over the concrete encasement of at least one (1.0) foot in rock and three (3) feet in other materials.

L. Water main under storm drain pipe or stream culvert shall be laid as near to horizontal as possible. The length of the water main shall be centered at the point of the crossing so that the joints shall be equidistant and as far as possible from the storm sewer or stream culvert. In addition, should 18" vertical separation not be maintained the water main shall be encased in concrete for the full width of the trench (12" minimum encasement on each side), with at least 12 inches of concrete beneath the pipe and 12 inches over top of the pipe. The length of the encasement shall be 10 feet each side of the storm sewer or stream culvert.

M. Water mains crossing sewer mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the sewer main and the outside of the water main. This shall be the case where the water main is either above or below the sewer main. At crossings, one full length of water main pipe shall be located so both joints will be as far from the sewer main as possible.

N. Set, align, position and properly connect new valves and operators for proper operation and to allow maximum access for maintenance. Provide proper and adequate clearance for valve operation. When operated, valves shall operate smoothly and operators shall not bind. Valves and valve operators shall be installed in accordance with the manufacturer's instructions. Thoroughly clean and remove all shipping materials prior to setting valves. Operate all valves from fully opened to totally closed before setting. Provide support and anchorage as required. Buried valves shall be provided with special supports such as crushed stone, concrete pads or a sufficiently tamped trench bottom so that the pipe will not be required to support the weight of the valve. Valve boxes shall not transmit shock or stress to the valve and shall be centered over the operating nut of the valve.

### 3.2 JOINT RESTRAINT

A. Concrete Thrust Blocks: Cast-in-place concrete thrust blocks shall be placed at all points of potential thrust as required in accordance with the standards included in these specifications and drawings. Thrust blocks shall be placed so that joints on mains will be accessible for repair. Thrust blocks shall be poured against undisturbed earth and shall be of a sufficient size to resist the thrust resulting from the specified hydrostatic test pressure.

B. Contractor shall use restrained joint ductile iron pipe and restraining elbows, tees, hydrants and plugs where indicated. Restrained joint pipe shall be used when one or more of the following conditions exist:

- Where indicated

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- Unsuitable trench conditions as directed by the Engineer.
- Unsuitable soil condition as directed by the Engineer.
- Interference with, or close proximity to buried structures, pipelines or utility lines.

C. Restrained Joint Pipe: When thrust blocks cannot be used, restrained joints shall be placed at all points of potential thrust. The number of joints to be restrained on each side of a fitting shall be determined by the pipe manufacturer and submitted to the Engineer for review and approval. The length of restrained pipe shall be sufficient to resist the specified hydrostatic test pressures and shall also take into account such factors as the burial depth, soil types and backfill material used. Restrained joint ductile iron pipe shall be of the restrained mechanical or push-on joint type. Mechanical joint retainer glands are not acceptable. Restrained joint piping shall sustain the indicated test pressures, as a minimum.

### 3.3 TESTING

A. Before being tested, water mains shall be backfilled between joints to a safe level and thrust restraint suitable to withstand the hydrostatic test pressure shall be in place. Pipe lines shall be thoroughly flushed to remove all foreign materials which may have entered during construction.

B. Test pressures shall be as specified in the paragraphs which follow.

C. Before applying the specified test pressure, air shall be expelled completely from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be left in place.

#### D. Hydrostatic Test

1. The trench shall be backfilled between joints before testing to prevent movement of pipe.
2. The length of water main under test shall be slowly filled with water and brought to test pressure by means of a pump connected to the pipe in a manner satisfactory to the Engineer, so as to obtain the specified hydrostatic test pressure at the highest point in the section of main under test. The water, pump, pipe connection and all necessary apparatus, shall be furnished and paid for by the Contractor. If desired, the Engineer reserves the right to furnish gauges for the test, but all necessary assistance for conducting the test will be furnished and paid for by the Contractor. All air must be expelled from the pipe line prior to the test period. The test pressure shall be applied for a period of two (2) hours.
3. The specified test pressure shall be held within 5 psi for the duration of the test.

#### E. Leakage Test

1. After the hydrostatic test proves satisfactory, a leakage test shall be conducted. The pressure maintained during the leakage test shall be as specified in the following paragraphs. The test shall be conducted in the same manner as the pressure test except that suitable equipment, supplied and paid for by the Contractor, shall be provided for measuring the amount of leakage. The duration of this test shall be twenty-four (24) hours.

2. No pipe installation will be accepted if the leakage is greater than the allowable leakage determined by the following:

a. The amount of leakage in piping shall be measured at the specified test pressure by pumping from a calibrated container. For new pipe tested at 150 psi for 24 hours allowable leakage shall be determined in accordance with AWWA C600 and the following table:.

Allowable Leakage	
Pipe Diameter (in.)	Leakage per 1,000 L.F. (gal.)
6	13.2
8	17.8
12	26.4
16	35.3
18	39.8
20	44.2
24	53.0

- If pipeline under test contains sections of various diameters, the allowable leakage shall be the sum of the calculated leakage for each pipe size.

The table has been calculated using the following formula:

$$L = \frac{\frac{1}{2} SDPT}{133,200}$$

Where

L	=	Allowable leakage (gal.)
S	=	Length of pipe (ft.)
D	=	Nominal pipe diameter (in.)
P	=	Average test pressure during leakage test (psi)
T	=	Testing time (hr.)

b. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time.



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F. Test pressures shall be as follows:

Hydrostatic Test Pressure (psig)	Leakage Test Pressure (psig)
150	100

G. Should any of these tests on a section of pipe line disclose an inability to hold the stipulated test pressure or leakage in an amount greater than that permitted, the Contractor shall, at his own expense, locate and correct any defects and retest same to the satisfaction of the Engineer.

### 3.4 DISINFECTION

A. Water mains shall be disinfected in accordance with AWWA C 651.

B. Prior to starting disinfection work verify that main installation is completed, cleaned and flushed. Complete outstanding work as required prior to disinfection.

C. Do not start work until conditions are satisfactory.

D. Inject disinfectant throughout system to obtain 50 to 80 ppm residual.

E. Starting at outlet closest to water source, bleed water from each outlet until water produces odor of disinfectant. Repeat process at each outlet throughout system.

F. Test will run for disinfectant residual at each of the following locations:

1. Ends of piping runs.

G. Maintain disinfectant in system for 24 hours.

H. If disinfectant residual is less than 25 ppm, repeat system treatment.

I. Flush disinfectant from system; permit no more than residual rate of incoming water or 1.0 ppm, whichever is greater. **Heavily chlorinated water shall be disposed of per Appendix B of AWWA 651.**

J. Retain the services of PaDEP certified Bacteriological Laboratory to collect and analyze water samples no sooner than 24 hours after flushing system.

K. Take water samples at the following locations:

1. Ends of piping runs.

L. If bacteriological test proves water quality to be unacceptable, repeat system treatment.

M. System shall remain isolated until such time that written test results are received.

END OF SECTION

## SECTION 02722

### GRAVITY SANITARY SEWER SYSTEM

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION OF WORK

- A. The extent of gravity sanitary sewer system work is as indicated on drawings and schedules, and by requirements of this Section.
- B. Sanitary sewer main shall be constructed of the materials indicated on the drawings.
- C. Refer to Section 02221 Utility Excavation, Backfill and Compaction for excavation and backfill required for sanitary sewage system.
- D. Gravity Sanitary sewer system shall include but not be limited to:
  - 1. All gravity sanitary sewer systems.
  - 2. Sanitary mains.
  - 3. Sanitary manholes.
  - 4. All excavating and backfill required for the gravity sanitary sewer system.
  - 5. Stakeout by Contractor from existing control points in field.

##### 1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Utility Excavation, Backfill and Compaction - Section 02221
- B. Concrete - Section 03300

##### 1.3 REFERENCE STANDARDS

- A. Pennsylvania Department of Transportation (PennDOT), Publication 408, "Specifications", dated 1990.
- B. American Society for Testing and Materials (ASTM)
  - A 185 Welded steel Wire Fabric for Concrete Reinforcement.
  - A 615 Deformed and Plain Billet - Steel Bars for Concrete Reinforcement.
  - B 221

- C 32 Sewer and Manhole Brick (Made from Clay or Shale).
  - C 443 Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
  - C 478 Precast Reinforced Concrete Manhole Sections.
  - C 923
  - D 1784
  - D 2321 Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
  - D 3034 Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings.
  - D 3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seal.
  - F 477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
  - F 789 Type PS-46 Poly (Vinyl Chloride) (PVC) Plastic Gravity Flow Sewer Pipe and Fittings.
- C. American Water Works Association (AWWA)

#### 1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for sewer system materials and products. Certificates of conformance for all materials shall be submitted in accordance with Division 1, assuring conformance with these specifications. All pipe and appurtenances specified herein shall be covered by a guarantee certificate furnished by the Contractor and signed by an officer of the pipe manufacturer.
- B. Shop Drawings: Submit shop drawings for sanitary sewer systems, showing piping materials. Include details of underground structures, connections, manholes, covers, castings, fittings and pipe.
- C. Record Drawings: At project closeout, submit record drawings of installed sanitary sewer piping and products, in accordance with specifications.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Obtain materials from firms regularly engaged in manufacture of sanitary sewer system's products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Plumbing Code Compliance: Comply with applicable portions of National Standard Plumbing Code pertaining to selection and installation of sanitary sewage system materials and products. Comply with local codes and ordinances.

## PART 2 - PRODUCTS

### 2.1 PIPES AND PIPE FITTINGS

- A. General: Provide pipes of the following materials as indicated on the drawings and specified herein. Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated.
- B. Polyvinyl Chloride (PVC) Sewer Pipe and Fittings: Shall conform to ASTM D 3034 SDR 35 sewer pipe and fittings. PVC material shall conform to ASTM D1784, Cell Class 12454B.
  - 1. Fittings: PVC elastomeric joints complying with ASTM D3212 using elastomeric seals complying with ASTM F477. Elastomeric gasket shall be rubber and shall comply with the physical requirements of ASTM F477.
- C. Wye Branches:
  - 1. Wherever necessary, the Contractor shall lay "Y" branches of the same materials and strength as the sewer main for the purpose of making building connections. The "Y" branches shall be laid at an angle as shown on the construction details.
  - 2. The spur of the "Y" branch shall be supported by Class "B" concrete as shown on the drawings. "Y" branches shall not be backfilled until location has been made by the Contractor in the presence of the Engineer.

### 2.2 SANITARY SEWER MANHOLES

- A. General: Provide precast reinforced concrete sanitary manholes as indicated, and complying with ASTM C478.
- B. The sections shall conform to the requirements of "Specifications for Precast Reinforced Concrete Manhole Sections" (ASTM C478), except that the joints shall be sealed with a Preformed Plastic Gasket that meets or exceeds all requirements of Fed. Spec. SS-S-00210, "Sealing Compound Preformed Plastic for Pipe Joints", Type 1, Rope Form.
- C. The Sealing Compound shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler, and shall contain no solvents, irritating fumes or obnoxious odors. The compound shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength. It shall be supplied in extruded rope-form of suitable cross-section and of such sizes as to seal the joint space when the sections are set in place. The sealing compound shall be protected by a suitable removable two-piece wrapper. The two-piece wrapper shall be so designed that one-half may be removed longitudinally without disturbing the other half to facilitate application of the sealing compound.
- D. The top of base walls, the ends of reinforced concrete risers and the bottom ends of precast tops shall be so formed that when risers and tops are assembled with the base, they will make a continuous manhole. Joints shall be of such design as will permit effective joining and placement without irregularities in the interior wall surface of the manhole.

- E. Manhole barrels shall consist of riser and top sections with a minimum wall thickness of 5 inches. The top section shall be an eccentric conical section with thickened upper walls with the smallest inside diameter equal to 24 inches, to receive the manhole frame and cover. No more than 2 lift holes shall be cast in each barrel or top section.
- F. Manhole riser and top sections shall be designed, manufactured, tested, finished and marked in accordance with this specification and ASTM C478.
- G. Top: Precast concrete, of concentric cone, eccentric cone, or flat slab top type, as indicated.
- H. Base: Precast concrete, with base riser section and separate base slab, or base riser section with integral floor, as indicated.
- I. Steps: Aluminum for manhole steps shall be manufactured and tested in accordance with ASTM B221 Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes, Alloy 6061 T6. Embedded ends of aluminum steps shall have 2 coats of bitumastic. Steps shall be located a minimum of 6 inches from the ends of riser and top sections.
- J. Pipe Connectors: Resilient, complying with ASTM C923.
- K. Manhole Frame and Cover:
  - 1. Shall conform to details on the drawings. Manhole frame and cover shall be Bridgestate Foundry Corporation Pattern Number 1007C or approved equal.
  - 2. Castings shall be tough gray iron approximate weight 450 lbs., free from cracks, holes, swells and cold shuts. All manhole castings shall be made accurately to the pattern and to the dimensions shown on plans, and shall be planed where marked, or where otherwise necessary to secure perfectly flat and true surfaces. All lids which "rock" and do not lie solid after construction is finished will be condemned and must be replaced by perfect lids.
  - 3. No plugging, burning in or filling will be allowed. Covers must fit the frames in any position. All castings shall be carefully coated, both inside and out, with coal-tar pitch varnish. The varnish shall be made from a good quality of coal-tar, with sufficient oil added to make a smooth coating, tough and tenacious when cold, and not brittle nor with any tendency to scale off.
  - 4. Anchor bolts for bolting manhole frame to the precast manhole shall be 3/4" diameter galvanized all-thread cinch anchor with 5" for embedment in the manhole top and a minimum 2-inch projection through the bars of the frame.

## 2.3 BRICK AND MORTAR

- A. Brick: Conform to ASTM C32 Grade SM.
- B. Mortar
  - 1. Aggregate: ASTM C144.

2. Portland Cement: ASTM C150, Type I, of natural color - or white to produce required color.
  3. Hydrated Lime: ASTM C207, Type S.
  4. Water: Clean and potable.
- C. Mortar Applications: One part portland cement and two parts sand with hydrated lime added not to exceed 20% of the "cement by weight.

## 2.4 CONCRETE AND REINFORCING

- A. Concrete shall conform to drawings or specifications.
- B. Reinforcing mesh and bars shall conform to ASTM A185 and ASTM A615, Grade 60.

## 2.5 STONE AGGREGATES

- A. Crushed stone shall conform to the requirements for Coarse Aggregate in accordance with PennDOT Specification section 703.2, Size Number 57, Type C or better, as approved.

## 2.6 CONNECTORS TO EXISTING MANHOLES

- A. Flexible connectors shall be used (when required) to insert new PVC or ductile iron pipe into existing manholes. Pipe clamp and Korband shall be stainless steel, connector shall be EPDM rubber. Flexible connectors shall be Kor-N-Seal as manufactured by NPC Inc., or equal. Connection shall be at the same invert as the existing pipe, or as indicated on the drawings.

## 2.7 PIPE TO PIPE CONNECTORS

- A. Flexible couplings shall be used to connect new pipe to existing pipe. Flexible couplings shall be as manufactured by Fernco, or equal, with #305 stainless steel straps, conforming to ASTM #C-594-70.

## 2.8 GROUT

- A. Nonshrinking Grout
  1. Required for patching manholes, pipes and plugging.
  2. Grout shall be nonmetallic, as manufactured by one of the following:
    - a. Crystex, L and M Construction Chemicals, Inc.
    - b. Five Star Grout, U.S. Grout Corporation.

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- c. Masterflow 713 grout, Master Builder's, Inc.
  - d. Sauereisen F-100, Sauereisen Cement Company.
  - e. Supreme Grout, Gifford-Hill and Company.
  - f. Ferrolith C, Sonneborn-Contech.
  - g. EUCO NS, Euclid Chemical.
3. Prepare and place to manufacturer's printed instructions.



## PART 3 - EXECUTION

### 3.1 INSTALLATION OF PIPE AND PIPE FITTINGS

#### A. General:

1. Install piping in accordance with governing authorities having jurisdiction, except where more stringent requirements are indicated. All excavating and backfill shall conform the specifications.
2. Inspect piping before installation to detect apparent defects. Mark defective materials with paint and promptly remove from site.
3. Install gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements.
4. Shall be accomplished only in the presence of the Engineer, or his authorized representative. Adequate and suitable equipment and appliances for safe and convenient handling and laying of pipe shall be used.

#### B. PVC Pipe: Install in accordance with manufacturer's installation recommendations, and in accordance with ASTM D2321.

#### C. Cleaning Piping:

1. Clear interior of piping of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed.
2. In large, accessible piping, brushes and brooms may be used for cleaning.
3. Place plugs in ends of uncompleted conduit at end of day or whenever work stops.
4. Flush lines between manholes if required to remove collected debris.

#### D. Joint Adapters: Make joints between different types of pipe with standard manufactured adapters and fittings intended for that purpose.

#### E. Closing abandoned utilities:

1. Close open ends of abandoned underground utilities which are indicated to remain in place. Provide sufficiently strong closures to withstand hydrostatic or earth pressure which may result after ends of abandoned utilities have been closed.
2. Close open ends of concrete or masonry utilities with not less than 8" thick brick masonry bulkheads.
3. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Wood plugs are not acceptable.

F. Laying Pipe:

1. Pipes shall be laid true to the lines and grades shown on the plans. The grade shown on the profile is the invert to which the work must conform. Work not conforming to the grade shall be corrected by the Contractor at his own expense. The locations of the proposed lines are shown on the plans. Approximate depths are shown on the plans.
2. The Contractor shall use a laser to control alignment and grade. The laser shall be set up and operated according to the manufacturers instructions and the Contractor shall possess all required licenses and permits for laser operation. After the trench has been brought to the proper grade as heretofore specified, the pipe and fittings shall be laid. Care shall be taken to lay the pipe to true lines and grades. Every pipe laid shall be tested as to grade and alignment. Care must be taken to fit the joints together properly so that the centers of the pipes shall be in one and the same straight line, and so as to give an opening of even thickness, all around between spigot end of pipe and the socket end of specials and fittings.
3. Carefully handle and lower pipe into the trench. Take special care in laying pipe, to ensure that each length abuts against the next in such a manner that there shall be no shoulder or unevenness of any kind along the inside of the bottom half of the pipe line. No wedging or blocking will be permitted in laying any pipe unless by written order or permission from the Engineer.
4. Bed each pipe section on a solid foundation before making successive joints. Bring no pipe section into position until the preceding length has been thoroughly embedded and secured in place. Correct any defects due to settlement at Contractor's own expense. Dig bell holes sufficiently large to ensure that the pipe is firmly bedded on the full length of the barrel. All pipe bedding shall be as shown on the drawings.
5. Use proper and suitable tools and appliances for the safe and convenient handling and laying of pipes.
6. Thoroughly clean each pipe section before placement and clean until the acceptance of the completed work. Provide and install carefully fitted strong stoppers in the open ends of all pipe lines so as to keep dirt and other substances from entering. Keep stoppers in the ends of the pipe lines at all times when laying is not in actual progress.
7. Keep the excavation in which pipe is being laid free from water and make no joint under water. Do not allow water to rise in the excavation until the joint material has received its set. Use the greatest care to secure watertightness and to prevent damage to, or disturbance of the joints during the refilling process, or at any time. After pipes have been laid and the joints have been made, allow no walking on or working over them, except such as may be necessary in tamping, until there is a covering at least two feet in depth, over their top.
8. Locate branches in the position designated by the drawings. Field cut short pieces of lateral sewer to meet this condition. Keep on the work site, at all times, factory approved equipment to machine and adapt the field cut end of short pieces of pipe to standard couplings and jointing materials.
9. Lay no pipe upon a foundation into which frost has penetrated nor at any time when the

Engineer shall deem that there is danger of the formation of ice or other penetration of frost at the bottom of the excavation. Work may proceed during sub-freezing conditions, at the discretion of the Engineer, provided that the minimum length of open trench and promptness of refilling are observed.

10. Pipe and accessories shall be handled in such a manner as to insure delivery in sound, undamaged condition. Particular care shall be taken not to injure the pipe coating. No other pipe or material of any kind shall be placed inside of any pipe or fitting at any time after the coating has been applied.
11. Wherever necessary, the Contractor shall lay WYES of the same material and strength as the sewer main for the purpose of making building connections. The WYES shall be laid at an angle to meet existing conditions. WYES shall not be backfilled until location has been made by the Engineer.
12. House laterals from the "Y's" or existing "T's" to the point specified shall be laid by the Contractor. All laterals shall be four (4) inch diameter pipe. Lateral connections shall be construction in accordance with the details shown on the drawings. In general, specifications for materials, workmanship and watertight construction for laterals shall be the same as for sewers.
13. The Contractor shall also take any and all measures to keep the pipe clean and free from deposits and protect the pipe from damage. If the pipe is damaged from any cause or becomes either partly or completely filled with dirt, stones, sand or other debris, the Contractor shall make all necessary repairs and remove, at his own expense, all such material. Upon refusal to do so, it will be done by the Owner and the cost thereof shall be charged as money paid to the Contractor.
14. Before lowering and while suspended, the pipe shall be inspected for defects and rung with a light hammer to detect cracks. Any defective, damaged or unsound pipe will be rejected. Deflections from a straight line or grade, made necessary by vertical curves or horizontal curves or offsets, may be made with the pipe except that the deflection shall not exceed 5 degrees for sizes through twelve (12) inches. If the required alignment requires a deflections in excess of those specified above, the Contractor shall either provide, at his own expense, special bends or a sufficient number of shorter lengths of pipe to provide angular deflections within the limit set forth above. The spigot shall be centered in the bell and the pipe pushed into position and brought into true and specified alignment. Except where necessary in making connections with other lines, pipe shall be laid with the bells facing the direction of laying and for lines on an appreciable slope, bells shall face upgrade.
15. The gasket seat in the socket and the gasket shall be wiped with a cloth. The gasket shall be placed in the socket with the large round end entering first. It can then be sprung into the gasket seat so that the groove fits over the bead in the seat. A thin film of lubricant shall then be applied to the inside surface of the gasket that will come in contact with the entering pipe. Only non-toxic vegetable soap lubricant as recommended by pipe manufacturer shall be used. Mineral oil or petroleum base lubricant shall never be used. The plain end of the pipe to be entered, shall be wiped clean and placed in approximate alignment with the bell of the pipe to which it is to be joined. In some cases it might be desirable to apply a thin film of lubricant to the outside of the plain end for about one (1)

inch back from the end. When subfreezing temperatures prevail, the joint should assemble easier if lubricant is applied only to the gasket.

16. All gaskets shall be protected from cold weather. Gaskets shall not be exposed to temperatures below 50°F for more than five (5) minutes.
17. After lubrication, the plain end of the pipe shall then be lifted and started into the socket so that it is in contact with the gasket. The joint shall be made up with entering pipe deflected at an angle. The joint shall be made by exerting sufficient force on the entering pipe so that its plain end is moved past the gasket (which is thereby compressed) until it makes contact with the base of the socket. This can be accomplished by one of the methods recommended by the pipe manufacturer, by crowbar, fork tool or jack type tool.
18. When pipe is cut in the field, the cut end shall be conditioned so that it may be used to make up the next joint. The outside of the cut end should be tapered back about 1/8 inch at an angle of about thirty (30) degrees with the centerline of the pipe by using a coarse file or a portable grinder. The operation removes any sharp, rough edges which otherwise might injure the gasket.
19. When installing push-on or mechanical joint pipe in below freezing temperatures, keep lubricant and gaskets workable by leaving them in hot water bath when not actually in use, or in a heated storeroom.
20. When the sewers have been laid and backfilled, the Engineer will make an inspection. All defects found will be corrected by and at the sole expense of the Contractor.

G. Interior Inspection:

1. Inspect piping to determine whether line displacement or other damage has occurred.
2. Make inspections after lines between manholes or manhole locations, have been installed and approximately 2 feet of backfill is in place, and again at completion of project.
3. If inspection indicated poor alignment, debris, displaced pipe, infiltration or other defects, correct such defects, and reinspect.

H. By-Pass Pumping/Fluming

1. The Contractor shall not be permitted to flume the sewage while laying new pipe, he shall by-pass pump from the manhole above the section of pipe he is working on to the manhole below.
2. The Contractor shall be permitted to flume the sewage during nights and weekends, subject to the approval of the Engineer. All pipe used to flume the flow shall be at least the same size diameter as the existing pipe being flumed, unless written permission to the contrary is given by the Engineer, and must be approved by the Engineer prior to installation.
3. Prior to using the pipe for fluming the sewage, the Contractor shall clean it of all debris.

4. The contractor is responsible for maintaining all by-passes and flumes throughout the duration of the contract. Any back-ups caused by the flume shall be the sole responsibility of the Contractor.

I. Removal of Pipe

1. No payment shall be made for removal and disposal of existing pipe and it shall be assumed the Contractor has made provisions for same in his bid prices.

### 3.2 SANITARY MANHOLES

- A. General: Place precast concrete sections as indicated. Where manholes occur in pavements, set tops of frames and covers flush with finish surface. Elsewhere, set tops flush with finish surface, unless otherwise indicated.
- B. Install in accordance with ASTM C891.
- C. Provide preformed joint sealing compound as specified on the drawings.
- D. Construct masonry for manholes and for adjusting existing manholes in accordance with the requirements of PennDOT Specification section 663.3, latest revision.
- E. Handling:
  1. All precast manhole components shall be lifted and moved by use of suitable lifting slings and plugs that will not damage the precast manhole lip.
  2. All damage to precast sections shall be thoroughly repaired in the presence of the Engineer. Repair and patching of minor breaks shall be done by chipping and scarifying the defective area before application of grout. Sufficient time shall be allowed for curing before the precast sections are put together. Concrete cast-in-place bases shall be specially formed and keyed to accommodate the bottom precast section.
- F. Placement:
  1. Manhole bases shall rest upon a base of sound, level, AASHTO No. 57 compacted stone.
  2. Manhole sections shall not be set by wedging or placing shims to secure proper level and manholes shall not be backfilled without the permission of the Engineer.
- G. Masonry Work: The top of all precast manholes may be brought to proper grade for receiving manhole frames by using not more than three courses of brick or precast grade rings. Masonry construction shall be performed by experienced and qualified workmen only. All work shall be laid plumb, straight, level, square and true. Brick shall be laid in full beds of mortar and shoved into place. All joints shall be full and not more than one-half inch in thickness. The Contractor shall set in place and bond in the masonry all necessary steps and miscellaneous items specified elsewhere. The masonry walls shall be parged on the inside and outside with a one-half inch coat of Portland Cement mortar.

H. Flow Channels and Bench Walls:

1. The flow channels and bench walls shall be monolithically constructed with the base.
2. The minimum depth of flow channel shall be equal to 3/4 the diameter of the largest sewer in the manhole to which it connects. The channel shall be graded to give a smooth, uninterrupted flow through the manhole.
3. Bench walls shall be pitched a minimum of 1 inch per foot from the inside periphery of the manhole to the edge of the flow channel.

I. Bitumastic Exterior Coating:

1. Prior to delivery, the entire exterior manhole surface shall be coated with two (2) coats, producing a dry film thickness of .016 inches (16 mils) per coat of Bitumastic Super Service Black, as manufactured by Koppers Co., Inc., equivalent of Mobil Chemical Co., or equal. Prior to backfill, any damaged coating shall be repaired/reapplied to the exterior of the manhole.

3.3 MANHOLE FRAMES AND COVERS

- A. Manhole frames and covers shall be brought to proper grade as previously noted, set in 1/4" bed of mastic, and anchored in place with the four (4) 3/4" diameter anchor bolts which shall be securely embedded in the top of the manhole.

3.4 ACCEPTANCE TESTING:

A. GENERAL

1. After the gravity sewers have been laid and backfill placed to two (2) feet above the pipe, a light will be flashed between manholes, or, if the manhole has not yet been constructed, between the location of manholes, by means of a flashlight or mirrored light, to determine whether the alignment of the main is true and whether any pipe has been displaced subsequent to laying. If alignment is correct and no other defects are disclosed, backfilling may be continued. If the test shows poor alignment of the main, misplaced pipe or other defects, such defects shall be remedied by the Contractor, as required by the Engineer, before the work of backfilling proceeds.
2. After backfilling, the Contractor shall make tests to ascertain if joints are tight. Leaky or poor joints shall be repaired, or removed at once by the Contractor to the satisfaction of the Engineer.
3. No section of gravity sewer lines shall be tested for leakage before backfilling in that section has been completed. If this condition has been fulfilled, the sewer lines shall be tested for leakage between manholes as the work progresses.
4. The Contractor shall perform the tests and he shall furnish all apparatus and materials required for the tests, the cost of which shall be included in the Contract bid.

5. The tests will be witnessed by the Engineer.
6. The following tests shall be made:
  - a. Low pressure air test
  - b. Mandrel test for PVC pipe
  - c. Manhole vacuum test
  - d. Mirror test
7. Cost for testing shall be included in the Contractor's bid.

**B. AIR TEST**

1. The sewer mains and/or laterals shall be tested for leakage by the use of low pressure air as specified hereinafter and as approved by the Engineer. Each manhole run will be tested separately as the construction progresses, before trench surface restoration, and preferably with not more than four (4) manhole runs constructed ahead of testing.
2. Equipment shall be as manufactured by Cherne Industrial, Inc. of Edina, Minnesota, N.B. Products, New Britain, PA or equal. Equipment used shall meet the following minimum requirements:
  - a. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.
  - b. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
  - c. All air used shall pass through a single control panel.
  - d. Three individual hoses shall be used for the following connections:
    - From control panel to pneumatic plugs for inflation
    - From control panel to sealed line for introducing the low pressure air.
    - From sealed line to control panel for continually monitoring the air pressure rise in the sealed line.
3. Procedures:
  - a. All pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig. The sealed pipe shall be pressurized to 5 psig. The plugs must hold against this pressure without having to be braced.
  - b. After a manhole reach of pipe has been backfilled and cleaned, and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each

manhole and inflated to 25 psig. Low pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psig greater than the average back pressure of any groundwater than may be over the pipe (3.5 psig minimum pressure in the pipe). At least two (2) minutes shall be allowed for the air pressure to stabilize.

- c. After the stabilization period, the air hose from the control panel to the air supply shall be disconnected. The portion of line being tested shall be termed "Acceptable" if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig (greater than the average back pressure of any groundwater that may be over the pipe) shall not be less than the time shown for the given diameters:

8" Pipe = 4.0 minutes  
10" Pipe = 5.0 minutes  
12" Pipe = 6.0 minutes  
15" Pipe = 7.0 minutes  
16" Pipe = 7.0 minutes  
18" Pipe = 9.0 minutes

### C. MANDREL TEST

1. Deflection tests shall be successfully performed on the complete installation of PVC pipe by means of a mandrel test.
2. The Contractor shall utilize a 5% deflection mandrel to ensure that PVC pipe deflection during installation has not been exceeded. Mandrel test shall be conducted no earlier than 30 days after compaction of backfill.
3. Mandrel Test Procedure
  - a. Completely flush the line making sure the pipe is clean of any mud or debris that would hinder the passage of the mandrel.
  - b. During the final flushing of the line, attach a floating block or ball to the end of the mandrel pull rope and float the rope through the line. (A nylon ski rope is recommended).
  - c. After the rope is threaded through the line, connect the pull rope to the mandrel and place the mandrel in the entrance of the pipe.
  - d. Connect a retrieval rope to the back of the mandrel to pull it back if necessary.
  - e. Remove all the slack in the pull rope and place a tape marker on the rope at the ends of the pipe.
  - f. Draw mandrel through the sewer line. If any irregularities or obstructions are encountered in the line, corrective action shall be taken as required.
  - g. If a section with excessive deflection is found, it shall be located and excavated. The pipe shall be inspected for damage; if any damaged pipe is found, it shall be replaced



at the Contractor's expense; if pipe is not damaged, replace and thoroughly tamp the haunching and initial backfill; replace remainder of backfill.

- h. Re-test this section for acceptance.

#### D. MANHOLE VACUUM TEST

1. Contractor shall supply all equipment and materials to vacuum test each manhole. Equipment and material shall be approved by the Engineer.
2. Each Manhole shall be tested after backfilling.
3. Prior to testing all lift holes shall be plugged with an approved non-shrink grout.
4. All pipes entering the manhole shall be plugged, taking care to securely brace the plug from being drawn into the manhole.
5. The test head shall be placed at the inside of the top of the cone section and the seal inflated in accordance with the manufacturer's recommendations.
6. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9 inches. The manhole shall pass if time is greater than 5 minutes for 48" diameter, 6 minutes for 60", and 7 minutes for 72" diameter manholes.
7. If the manhole fails the initial test, necessary repairs shall be made with a non-shrink grout while the vacuum is still being drawn. Retesting shall proceed until a satisfactory test is obtained.

### 3.5 CONCRETE CONSTRUCTION

- A. All concrete construction shall be in accordance the specifications.

### 3.6 CONCRETE ENCASEMENT

- A. Perform all concrete encasing as called for on the plans. Concrete construction shall be in accordance with the specifications. Formwork for encasement is not required and concrete may be placed directly against the ground.

END OF SECTION

SECTION 02930

LAWNS AND GRASSES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work shall consist of the temporary seeding required for erosion control purposes and the permanent seeding and sodding required to restore and stabilize all areas disturbed by construction activity that are not required to be paved. Contractor shall apply seed, sod, limestone, fertilizer, mulch, mulch anchoring, water, and other items incidental thereto and required for a complete installation.

B. Restoration involves the repair or replacement of all items disturbed by construction except those items specifically indicated by the Engineer to be removed. Restoration when complete should render the disturbed area equal to or better than its original condition prior to construction.

C. All lawn areas disturbed shall be seeded or sodded as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Soil Erosion and Sediment Control - Section 312100.

B. Finish Grading - Section 02260.

1.3 SUBMITTALS

A. Manufacturer's Test Reports - Submit certificates for the following:

1. Certificate of Sod.
2. Certificate of Seed.
3. Certification of Bulk Fertilizer.

1.4 REFERENCE STANDARDS - Comply with the following:

A. Association of Official Seed Analysts.

B. American Sod Producers Association (ASPA) "Guideline Specifications to Sodding"

C. Pennsylvania Department of Transportation (PennDOT) Publication 408, "Specifications", latest edition.

PART 2 - PRODUCTS

## 2.1 TOPSOIL

A. Onsite Topsoil: Onsite soil material from the top 6 inches of ground surface, as available in stockpiles, and as approved by Engineer.

B. Offsite Topsoil: If on-site topsoil is insufficient in quantity to provide specified thickness, provide topsoil from approved off-site sources as required to complete the work. Off-site topsoil shall meet the following minimum requirements.

1. Topsoil shall be fertile, friable, well drained, pH range of 6.0 to 6.5, free of sub-soil, toxic substances harmful to plant growth without clay lumps, stones, roots or debris. Analysis of content shall be as follows:

Sand	-	35% to 40%
Clay	-	15% to 20%
Organic Matter	-	2.5%
Silt	-	Balance

2. Test off-site topsoil by a soils testing laboratory retained and compensated by the contractor and approved by the engineer and submit copy of test report for approval by the engineer.

## 2.2 SEED

A. Seed shall conform to applicable State and Federal regulations and to test provisions of Association of Official Seed Analysts. Seed shall be mixed and delivered in clean, sealed bags bearing certified analysis. Submit certificates of analysis for approval.

B. Seed mix shall be in conformance with the drawings.

## 2.3 SODDING

### A. General

1. This work shall consist of furnishing, placing and maintaining cultivated sod on designated areas in accordance with these specifications and within reasonably close conformity to the lines and dimensions shown on the contract drawings or as directed by the Engineer.

### B. Materials

1. Sod: Provide strongly rooted sod, not less than two (2) years old and free of weeds and undesirable native grasses. Provide only sod capable of growth and development when planted (viable, not dormant). Provide sod composed principally of the following:

Spreading Fescue	Fortess	30
Chewings Fescue	Banner	30
Kentucky Bluegrass	Kenblue	30

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Perennial Rye

Manhattan

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2. A sample of the sod to be installed shall be supplied to the Owner or his authorized representative for approval prior to delivery.

C. Construction Requirements

1. Sod shall be cut in rectangular sections measuring twelve (12) inches to twenty-four (24) inches wide and two (2) feet to six (6) feet long in order to permit handling without tearing or breaking. The thickness of the section shall be approximately 3/4 inch.

2. If the grass is longer than two (2) inches, it shall be mowed to a height of one and one half (1½) inches prior to removal of the sod. All sod shall be in a well-moistened condition when delivered to the site.

3. All sod shall be placed within forty-eight (48) hours after being cut. Should temporary storage be required, sod shall be protected from direct sunlight and drying. Dried-out sod will not be accepted.

4. Prior to placing any sod, all grading and soil preparation shall have been completed as previously specified. Soil shall be moist prior to placing sod.

5. Sod shall be placed at times when moisture and temperature conditions are suitable. Sod shall not be cut or placed when the temperature is lower than thirty-five (35) degrees Fahrenheit.

6. Sod shall be carefully placed by hand with tight joints and no overlap. Pitchforks or other tools which tend to damage to sod shall not be used and dumping from vehicles will not be permitted. Transverse joints shall be broken or staggered. All sod shall be thoroughly watered to the point of saturation immediately after placing.

7. After watering, the sod shall be sufficiently tamped with an approved tamper to close all joints and insure close contact between sod and sod bed. After tamping, the sod shall present a smooth even surface, free from bumps and depressions. If so directed, a light roller, weighing not more than sixty-five (65) pounds per foot-width, shall be used to complete firming and smoothing the sod. On all slopes, sod shall be placed with the long axis parallel to the contour starting at the bottom of the slope. Joints shall be staggered.

8. In ditches and on slope areas, each strip of sod shall be staked securely with at least one (1) wood stake for each two (2) square feet of sod. Stakes shall be one-half (½) inch by one (1) inch with a length of eight (8) to twelve (12) inches as directed. Stakes shall be driven flush with the top of the sod, and with the long face parallel to the slope contour.

2.4 LIMESTONE - Ground agricultural dolomitic limestone, 90% calcium carbonate equivalent, conforming to standards of Association of Official Agricultural Chemists and applicable State and Federal regulations.

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2.5 FERTILIZER - Conforming to standards of Association of Official Agricultural Chemists, delivered in sealed and labeled bags, or in bulk with certification as to quality and analysis. Nitrogen source shall be at least 33% water insoluble. Fertilizer shall have the following formulations:

- Basic Fertilizer - 0-20-20.
- Starter Fertilizer - 10-18-10.
- Hydroseeding - 10-10-10.

2.6 SOIL STABILIZING AGENT - For use in hydroseed mix only. Material shall be equal to one of the following:

- "Verdyol Complex" - Weyerhaeuser Company.
- "Curasol" - Wolbert Master Associates.
- "Terra-Tack" - Grass Growers, Inc.
- "J-Tac" - Reclamare Company.

## 2.7 MULCH MATERIAL

A. General Use - Straw, salt marsh hay, or a combination of both. Material shall be reasonably weed free, not brittle or overly decomposed.

B. For Hydraulic Seeding - Wood cellulose fiber mulch, containing nontoxic green dyemarker.

2.8 MULCH ANCHORAGE MATERIAL - Conform to requirements of Section 805.2 of the PennDOT specifications except that asphaltic binders are not allowed.

## PART 3 - EXECUTION

### 3.1 LANDSCAPE WORK

A. Furnish all labor, supervision, materials and equipment to do all grading, topsoiling, seeding and sodding of the areas disturbed by construction.

B. Only material that is acceptable to Engineers shall be used to do finish grading. Fills shall be carefully made, solidly compacted, and graded to walks and roadways. All excess excavation not required for grading shall be removed from the site.

C. Upon completion of finish grading, topsoil shall be spread to a finished six (6) inch minimum depth.

D. During all operations following topsoil spreading, surface shall be kept free from stones over one and one half (1½) inch in size or any rubbish, debris, or other material which will be detrimental to seeding or to maintenance.

E. No separate payment will be made for landscape restoration work, the cost thereof being included in the prices bid.

### 3.2 PREPARING TOPSOIL

A. Existing On-Site Topsoil for Fine Lawn Areas - Incorporate the following materials uniformly throughout the entire depth of topsoil by discing, rototilling, or other approved method, except starter fertilizer which shall be spread uniformly to the surface and raked into the soil.

1. Limestone - As specified on drawings.
2. Starter Fertilizer - As specified on drawings.

B. Off-Site Topsoil Fine Lawn and Temporary Lawn Areas - Incorporate the following materials uniformly throughout the entire depth of topsoil, except starter fertilizer which shall be spread uniformly to the surface and raked into the soil.

1. Limestone - As specified on drawings.
2. Starter Fertilizer - As specified on drawings.

C. Add starter fertilizer to surface of seed bed. Rake or drag smooth to final grade elevations, roll if necessary to stabilize in order to commence seeding. Remove ruts, mounds, and ridges on surface of topsoil. All stones, roots, or other debris greater than 1 inch visible on the surface shall be removed. Resulting holes shall be filled with specified topsoil, leaving a uniform planer surface. Contractor shall grade uniformly so soil surface does not have low spots which may collect water.

D. Seeding operation shall take place while topsoil is in friable, loose condition, with no crusting of the surface.

### 3.3 SEEDING

A. Seeding shall be done between the following dates.

1. Permanent Seedings - As specified on drawings.
2. Temporary Lawns - As soon as possible for Erosion Control purposes.

B. Seed during favorable weather conditions. Prepared bed shall be in moderately dry condition during seeding.

C. Sow the seed mix at the rates indicated on the drawings.

D. Sowing may be by the following optional methods:

1. Mechanical Power-Drawn Seeder - Combination grass planter and land packer or pulverizer. Plant seed not deeper than 1/4 inch. Keep seeding operation as close as possible to the contours and not up and down slopes. After seeding, compact with land roller, such as a cultipacker. With proper equipment, sowing seed and cultipacking in one operation is satisfactory.

2. Hopper Type Spreader - Manually-propelled or power-drawn hopper devices. Uniformly distribute the seed by sowing half the seed in one direction and the remainder at right angles to the direction of the first sowing. Cover seed an average depth of 1/4 inch by means of chain harrow, cultipacker, or other approved method.

3. Hydroseeding - Hydraulic broadcasting of prepared material are as follows:

- a. With written approval of the Engineer.
- b. Water - As Specified.
- c. 1,500 pounds of wood cellulose, plus 15% for slopes 5% and steeper.
- d. 2.75 tons of lime.
- e. 0.87 pounds of fertilizer.
- f. Soil stabilizer of type and at rate recommended by the manufacturer.
- g. Seed Mix - As specified.
- h. For a 3,000 gallon tank, multiply these quantities by 0.75. Mix and agitate all materials, except wood cellulose, in 2,200 gallons of water; then add wood cellulose, fill tank with water and continue the agitation. Seed promptly, under constant agitation of the mix, beginning when the complete mix is a uniform slurry. Limit coverage for the 3,000 gallon tank to 0.75 acre.
- i. Take precautions against overspray onto roads, curbs, sidewalks, building walls, and other surfaces except the ground areas. Contractor shall promptly clean all areas of overspray to the satisfaction of the Engineer.

E. For temporary seeding work, add to topsoil the lime, peat and basic fertilizer, as specified, and finish surface of topsoil reasonably smooth. At time of permanent seeding, turn over the temporarily seeded areas by disking, to kill the grass and weeds. Smooth and fine grade the surface, add starter fertilizer and follow with the permanent seeding work. Option - Temporary seeding may be done by hydroseeding method, including mulch and soil amendments.

### 3.4 SODDING

A. Provide sod in areas on slopes steeper than three horizontal to one vertical, within drainage swales, and in residential lawn areas as directed by the Engineer. Sod shall also be placed on the uphill edge of all walks parallel to slopes in excess of 8%.

B. Place sod on prepared topsoil bed as herein before specified for seeded areas. At the time sod is placed, topsoil shall be in a damp, friable, loose condition, with no surface crust.

C. Retain sod on slopes steeper than three horizontal to one vertical and in swales, using wooden pins driven into sod until top is flush with sod.

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D. In placing sod, keep rows parallel with contour lines. Keep the work true to finished grade, and tamp or roll to establish firm contact with the topsoil bed. Butt the pads tightly and stagger ends with those in adjacent rows. If sod separates, backfill with topsoil flush with sod and over seed.

### 3.5 MULCHING

A. Except hydroseeded areas, seeded areas sloped four horizontal to one vertical or greater and areas where lawn would be difficult to establish, shall be mulched at rate of 3 tons per acre.

B. Wood fiber mulch or soil stabilizing agents may be used, hydraulically applied in water at rate of 1,500 pounds of wood fiber per acre, plus 15% on slopes greater than four to one.

C. For dry-mulched areas, spray with anchorage material immediately after spreading the straw or salt marsh hay or both, in accordance with Section 805.3 of the PennDOT Specifications, in a method to bind the mulch to the soil and inhibit wind loss of the mulch. Do not apply anchorage material within 30 feet of building lines. Clean off misplaced spray from building walks, paving, light standards and bases, and other surfaces to the satisfaction of the Engineer.

#### D. Winter Weather Mulching

1. When winter weather prevents immediate establishment of permanent lawn cover, mulch the soil.

2. Use any of the following mulches at the rate stated per acre.

Straw ..... 3 tons

Cornstalks, shredded or chopped to lengths  
6 inches to 8 inches ..... 4 to 6 tons

Wood chips, minimum 2 inches depth of mulch

3. All mulches, except wood chips, shall be tucked into the soil about 3 inches by use of disc or other pull-type power equipment.

4. After mulch has afforded winter protection, it shall either be removed or worked into the soil.

### 3.6 WATERING

A. Water shall be supplied by Contractor.

B. Keep newly seeded and sodded areas moistened until the grass becomes well established.



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C. In event of insufficient rainfall, moisten areas every two or three days until the height of the grass is two (2") inches above grade. Thereafter, water in absence of rain every seven to ten days. When watering sod, make sure that water soaks through the sod into the topsoil bed below.

### 3.7 PROTECTIVE WORK

A. Provide incidental materials and work necessary to protect the work from damage. Prevent damage to property during these operations.

B. Protective work shall include wire line and stakes along walkways with cloth strips at 4 feet intervals as evidence of the wire and also "KEEP OFF" signs.

C. Defer work when continuation of construction work must occur over certain lawn areas.

### 3.8 MAINTENANCE PRIOR TO ACCEPTANCE

A. Maintain all seeded and sodded areas by properly mowing, watering, weeding, and similar care to keep the work in a clean and neat condition at all times.

### 3.9 CONDITIONS OF ACCEPTANCE

A. When average height of grass is about two and one half (2-1/2) inches it shall be cut to a height of one and one half (1-1/2) inches with approved mowing equipment, and at that time, any depressions or other irregularities in lawn surface shall be leveled and reseeded. Contractor's maintenance shall cease after third cutting, provided all areas are grassed and free from bare spots or large "off color" areas.

END OF SECTION

## **SECTION 03 30 00 - CAST-IN-PLACE CONCRETE**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

**A. Section Includes:**

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.
2. Form-facing materials.
3. Formwork shoring, bracing, and anchoring.
4. Reinforcing.

#### **1.2 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.

#### **1.3 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.

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- h. Curing procedures.
- i. Forms and form-removal limitations.
- j. Methods for achieving specified floor and slab flatness and levelness.
- k. Floor and slab flatness and levelness measurements.
- l. Concrete repair procedures.
- m. Concrete protection.
- n. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
- o. Protection of field cured field test cylinders.

#### 1.4 ACTION SUBMITTALS

A. Product Data: For each of the following.

- 1. Waterstops.
- 2. Portland cement.
- 3. Fly ash.
- 4. Slag cement.
- 5. Blended hydraulic cement.
- 6. Silica fume.
- 7. Aggregates.
- 8. 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.
- 9. Vapor retarders.
- 10. Floor and slab treatments.
- 11. Liquid floor treatments.
- 12. Curing materials.
  - a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.
- 13. Joint fillers.
- 14. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

- 1. Mixture identification.
- 2. Minimum 28-day compressive strength.
- 3. Maximum w/cm.
- 4. Slump limit.
- 5. Air content.
- 6. Nominal maximum aggregate size.
- 7. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.

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8. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

1. Reinforcing Shop Drawings: Comply with ACI SP-066:
  - a. Include placing drawings that detail fabrication, bending, and placement.
  - b. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
2. Construction and Shrinkage Joint Layout: Indicate proposed construction joints and shrinkage joints in slab-on-grade construction (where not shown on the drawings) required to construct the structure.
  - a. Location of construction and shrinkage joints is subject to approval of the Architect.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Ready-mixed concrete manufacturer.

B. 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. Aggregates.

C. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.

D. Preconstruction Test Reports: For each mix design.

E. Field quality-control reports.

1.6 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.

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- 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."

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301 (ACI 301M).
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.
- C. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

#### 1.8 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.

### PART 2 - PRODUCTS

#### 2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 and ACI 117 (ACI 301M) unless modified by requirements in the Contract Documents.

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## 2.2 FORM-FACING MATERIALS

### A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 03 30 00 "Cast-In-Place Concrete, and as follows:
  - a. Plywood, metal, or other approved panel materials.
  - b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    - 1) APA HDO (high-density overlay).
    - 2) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.

### B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.

### C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

### D. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

### E. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic [**or metal**] form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

## 2.3 WATERSTOPS

### A. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, in manufacturer's standard size.

### B. Subject to compliance with requirements, provide one of the following:

1. CCW (Carlisle); Mirastop NBW, 3/8 by 3/4 inch.
2. GCP Applied Technologies: ADCOR ES (no substitutions), 1/2 by 1 inch.

## 2.4 STEEL REINFORCEMENT

### A. Reinforcing Bars: ASTM A615/A615M, deformed.

### B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.

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- C. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

## 2.5 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A615/A615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
  - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
    - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
    - b. For slabs-on-grade, use precast concrete blocks spaced a maximum of three feet on center each way, unless indicated otherwise.
- C. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch (1.2908 mm) in diameter.
  - 1. Finish: Plain.

## 2.6 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## 2.7 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 or Type II.
  - 2. Fly Ash: ASTM C618, Class C or F.
  - 3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
  - 4. Blended Hydraulic Cement: ASTM C595/C595M, Type IS, portland blast-furnace slag, Type IP, portland-pozzolan cement.

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5. Silica Fume: ASTM C1240 amorphous silica.
- C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S 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: 1-1/2 inches for footings, 1 inch for walls and slabs-on-grade, and 3/4 inch for slabs less than 4' thick. Use #57 aggregate minimum for footings, walls, and slabs-on-grade.
  3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C260/C260M.
- E. 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.
  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.
- F. Water: Potable.

## 2.8 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 15 mil thick. Include manufacturer's recommended adhesive, pressure-sensitive tape, and accessories.
  1. Provide Stego Wrap 15 mil Vapor Barrier (no substitutions).



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## 2.9 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
1. Product: Subject to compliance with requirements, provide one of the following:
- a. Conspec by Dayton Superior; Intraseal.
  - b. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
  - c. Edoco by Dayton Superior; Titan Hard.
  - d. Euclid Chemical Company (The), an RPM Company; Euco Diamond Hard.
  - e. Kaufman Products, Inc.; SureHard.
  - f. L&M Construction Chemicals, Inc.; Seal Hard.
  - g. Meadows, W. R., Inc.; LIQUI-HARD.

## 2.10 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
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. BASF Construction Chemicals – Building Systems; Confilm.
  - b. Conspec by Dayton Superior; Aquafilm.
  - c. Dayton Superior Corporation; Sure Film (J-74).
  - d. Euclid Chemical Company (The), an RPM Company; Eucobar.
  - e. Kaufman Products, Inc.; Vapor-Aid.
  - f. L&M Construction Chemicals, Inc.; E-CON.
  - g. Meadows, W. R., Inc.; EVAPRE.
  - h. Sika Corporation; SikaFilm.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
1. Products: Subject to compliance with requirements, provide one of the following:
- a. Euclid Chemical Company (The), an RPM company; Diamond Clear VOX; Clearseal WB STD.
  - b. L&M Construction Chemicals, Inc.; Dress & Seal WB.
  - c. Meadows, W. R., Inc.; Vocomp-20.

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- F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.
  - b. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
  - c. Meadows, W. R., Inc. ; Vocomp-30.

## 2.11 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.
- 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 and Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

## 2.12 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.

## 2.13 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).

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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.
- 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.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of concrete.

## 2.14 CONCRETE MIXTURES

- A. Footings, grade beams, and tie beams: Normal-weight concrete.
  1. Minimum Compressive Strength: 3000 psi at 28 days.
  2. Maximum w/cm: 0.50.
  3. Slump Limit: 4 inches, plus or minus 1 inch, 8 inches, plus or minus 1 inch, for concrete with verified slump of 3 inches, before adding high-range water-reducing admixture or plasticizing admixture at Project site.
  4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery.
- B. Walls and Piers: Normal-weight concrete.
  1. Minimum Compressive Strength: 4000 psi at 28 days.
  2. Maximum w/cm: 0.48.
  3. Slump Limit: 3 inches, plus or minus 1 inch, 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches, before adding high-range water-reducing admixture or plasticizing admixture at Project site.
  4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery.
- C. Slabs-on-Grade: Normal-weight concrete.

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1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum w/cm: 0.48.
3. Minimum Cementitious Materials Content: 470 lb/cu. yd.
4. Slump Limit: 3 inches, plus or minus 1 inch, 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches, before adding high-range water-reducing admixture or plasticizing admixture at Project site.
5. 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. Slabs on Metal Deck: Normal weight concrete.

1. Minimum Compressive Strength: 3500 psi at 28 days.
2. Maximum w/cm: 0.48.
3. Minimum Cementitious Materials Content: 470 lb/cu. yd..
4. Slump Limit: 3 inches, plus or minus 1 inch, 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches, before adding high-range water-reducing admixture or plasticizing admixture at Project site.
5. 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. Work exposed to Weather: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4500 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 4 inches.
4. Air Content: 5 to 7 percent.

F. Interior Metal Pan Stairs And Landings: Normal weight concrete.

1. Minimum Compressive Strength: 3000 psi at 28 days.
2. Maximum w/cm: 0.50.
3. Minimum Cementitious Materials Content: 470 lb/cu. yd..
4. Maximum Size Aggregate: 1/2 inch.
5. Slump Limit: 3 inches, plus or minus 1 inch.

2.15 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and ASTM C1116/C1116M, and furnish batch ticket information.

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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. 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. Protection of In-Place Conditions:**

1. Do not cut or puncture vapor retarder.
2. Repair damage and reseal vapor retarder before placing concrete.

##### **B. 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 FORMWORK**

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork in accordance with ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (ACI 117M).
- C. Limit concrete surface irregularities as follows:
  1. Surface Finish-2.0: ACI 117 Class B, 1/4 inch (6 mm).
  2. Surface Finish-3.0: ACI 117 Class A, 1/8 inch (3.0 mm).

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- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
  - 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
  - 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  - 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
  - 1. Provide and secure units to support screed strips
  - 2. Use strike-off templates or compacting-type screeds.
  - 3. Depress slabs for gym floor finish system, refrigerator/freezer units and as indicated on the Drawings.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
  - 1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
  - 2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
  - 1. Determine sizes and locations from trades providing such items.
- K. Construction and Movement Joints:
  - 1. Construct joints true to line with faces perpendicular to surface plane of concrete.
  - 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 3. Place joints perpendicular to main reinforcement.
  - 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
    - a. 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.
    - a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

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- L. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
  - 1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
  - 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- M. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- N. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- O. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

### 3.4 INSTALLATION OF WATERSTOPS

- A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.
  - 1. Install in longest lengths practicable.
  - 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
  - 3. Protect exposed waterstops during progress of the Work.

### 3.5 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
  - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
- B. Clean and repair surfaces of forms to be reused in the Work.
  - 1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
  - 2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
  - 1. Align and secure joints to avoid offsets.
  - 2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

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### 3.6 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.

### 3.7 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
  - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
  - 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch (25 mm), not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318 (ACI 318M).
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
  - 1. Stagger splices in accordance with ACI 318 (ACI 318M).
  - 2. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
- G. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging.
  - 1. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches.
  - 2. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
  - 3. Lace overlaps with wire.

### 3.8 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.



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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. Extend vapor barrier up face of foundation wall to top of concrete slab on grade.
7. Extend vapor barrier down face of footing wall to top of concrete footing. Seal vapor barrier to footing with manufacturer's mastic.
8. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
9. Protect vapor retarder during placement of reinforcement and concrete.
10. 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.
11. Overlap new vapor retarder over existing vapor retarder where existing concrete slabs are cut. Seal vapor retarders together by overlapping 6 inches and taping the intersection of the two vapor retarders.

### 3.9 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 slabs-on-grade.
  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. Where indicated, use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  8. Where indicated, use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints (shrinkage joints) in Slabs-on-Grade: 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.

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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-grade: 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.
- F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

### 3.10 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. 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.
- E. 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, including welded wire fabric, 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.

### 3.11 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 not exposed to public view, or to be covered with a coating or covering material applied directly to concrete.
2. ACI 301 (ACI 301M) Surface Finish SF-3.0:

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- a. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.
- b. Remove projections larger than 1/8 inch (3 mm).
- c. Patch tie holes.
- d. Surface Tolerance: ACI 117 (ACI 117M) Class A.
- e. Locations: Apply to concrete surfaces exposed to public view.

B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings:

1. Smooth-Rubbed Finish:

- a. Perform no later than one day after form removal.
- b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
- c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
- d. Maintain required patterns or variances as shown on Drawings or to match mockups.

C. 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.

3.12 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 (ACI A117M) tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish.

C. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.

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2. Continue troweling passes and restraigten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155 (ASTM E1155M), for a randomly trafficked floor surface:
  - a. Slabs on Ground:
    - 1) Specified overall values of flatness,  $F_F$  35; and of levelness,  $F_L$  25; with minimum local values of flatness,  $F_F$  24; and of levelness,  $F_L$  17.
  - b. Suspended Slabs:
    - 1) Specified overall values of flatness,  $F_F$  35; with minimum local value of flatness,  $F_F$  24.

D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.

1. Coordinate required final finish with Architect before application.
2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

E. Broom Finish: Apply a broom finish to exterior concrete walks, patios, platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

### 3.13 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.

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- 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 6 inches (150 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.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.
  - 1. Cast-in inserts and accessories, as shown on Drawings.
  - 2. Screed, tamp, and trowel finish concrete surfaces.

### 3.14 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed 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.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

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- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  - 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.
    - d. Do not moist cure slabs to receive finishes.
  - 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, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape
    - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive roofing or waterproofing.
    - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
  - 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.
    - a. Removal: After curing period has lapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certified curing compound will not interfere with bonding of floor covering used on Project.
  - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a 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. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

### 3.15 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

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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 28 days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. 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 according to manufacturer's written instructions.

### 3.16 TOLERANCES

- A. Conform to ACI 117 (ACI 117M).

### 3.17 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 six 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.

### 3.18 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.



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- 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.

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- 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.

### 3.19 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 to 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 to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
  - 3. Testing agency to 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 to 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. Steel-reinforcement placement.
  - 2. Headed bolts and studs.
  - 3. Verification of use of required design mixture.
  - 4. Concrete placement, including conveying and depositing.
  - 5. Curing procedures and maintenance of curing temperature.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to 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.
  - 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. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete.

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- a. 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 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.
5. Compression Test Specimens: ASTM C31/C31M:
  - a. Cast and laboratory cure two sets of two 6-inch (150 mm) by 12-inch (300 mm) or 4-inch (100 mm) by 8-inch (200 mm) cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39/C39M.
  - a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
  - b. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
7. 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).
8. 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.
9. Additional Tests:
  - a. Testing and inspecting agency to 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 to be in accordance with ACI 301 (ACI 301M), Section 1.6.6.3.
10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

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- 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.

3.20 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.

**END OF SECTION**

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SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Concrete masonry units.
  - 2. Decorative concrete masonry units.
  - 3. Face brick.
  - 4. Date stone
  - 5. Mortar and grout materials
  - 6. Reinforcement.
  - 7. Ties and anchors.
  - 8. Embedded flashing.
  - 9. Miscellaneous masonry accessories.
  - 10. Cavity-wall insulation.
  - 11. Mortar and grout mixes.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
  - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
  - 2. Stone Trim Units: Show sizes, profiles, and locations of each stone trim unit required.
  - 3. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
  - 4. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Initial Selection:
  - 1. Decorative CMUs, in the form of small-scale units.
  - 2. Weep holes/vents.
- D. Samples for Verification: For each type and color of the following:
  - 1. Decorative CMUs.
  - 2. Face brick
  - 3. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project.
  - 4. Weep holes and vents.
  - 5. Accessories embedded in masonry.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of the following:
  - 1. Masonry units.
    - a. Include data on material properties.
  - 2. Cementitious materials. Include brand, type, and name of manufacturer.
  - 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
  - 4. Grout mixes. Include description of type and proportions of ingredients.
  - 5. Reinforcing bars.
  - 6. Joint reinforcement.
  - 7. Anchors, ties, and metal accessories.
- B. 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 C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
  - 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

### 1.4 QUALITY ASSURANCE

- 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.
- C. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- D. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.
  - 1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 48 inches long by 36 inches high.
  - 2. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.
  - 3. Clean one-half of exposed faces of panels with masonry cleaner indicated.
  - 4. Protect approved sample panels from the elements with weather-resistant membrane.
  - 5. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.

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- a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.
- 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.
  - 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 such deviations are specifically approved by Architect in writing.
  - 6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

#### 1.5 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 designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and 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.



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## 1.6 PROJECT 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 down both sides of walls and hold cover securely 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 ACI 530.1/ASCE 6/TMS 602.
  - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F 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 ACI 530.1/ASCE 6/TMS 602.

## PART 2 - PRODUCTS

### 2.1 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 Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

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## 2.2 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

## 2.3 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.
- B. CMUs: ASTM C 90.
  - 1. Density Classification: Normal weight unless otherwise indicated.
  - 2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
  - 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
  - 4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

## 2.4 BRICK

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
  - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
  - 2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
  - 3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
  - 4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Face Brick: Facing brick complying with ASTM C 216, grade exterior.
  - 1. Basis of Design Product: Interstate Brick "Mountain Red" field brick and "Canyon Rose", accent brick.
- C. Thin Brick: Facing thin brick veneer complying with ASTM C 1088, grade exterior.
  - 1. Basis of Design Product: Interstate Brick "Mountain Red" field brick and "Canyon Rose", accent brick.

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## 2.5 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, 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.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Davis Colors; True Tone Mortar Colors.
    - b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
    - c. Solomon Colors, Inc.; SGS Mortar Colors.
- E. Aggregate for Mortar: ASTM C 144.
  - 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 thick, use aggregate graded with 100 percent passing the No. 16 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 C 404.
- G. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent by same manufacturer.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ACM Chemistries; RainBloc for Mortar.
    - b. BASF Aktiengesellschaft; Rheopel Mortar Admixture.
    - c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
- H. Water: Potable.

## 2.6 LINTELS

- A. Refer to Structural Drawings for lintel types. Where masonry lintels are indicated, provide solid concrete masonry lintels: ASTM C1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength of not less than 3000 psi.

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## 2.7 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
  - 1. Interior Walls: Hot-dip galvanized, carbon steel.
  - 2. Exterior Walls: Hot-dip galvanized, carbon steel.
  - 3. Wire Size for Side Rods: 0.148-inch diameter.
  - 4. Wire Size for Cross Rods: 0.148-inch diameter.
  - 5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o .c.
  - 6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.
- D. Masonry-Joint Reinforcement for Multiwythe Masonry: Adjustable (two-piece) type, ladder 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 (1.6 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 3/8-inch (16 mm) cover on outside face.

## 2.8 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
  - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 1064/A 1064M; with ASTM A 153/A 153M, Class B-2 coating.
- B. 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- diameter, stainless-steel wire.
  - 2. Tie Section: Triangular-shaped wire tie made from 0.187-inch-diameter, hot-dip galvanized steel wire.
- C. 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 (1.6 mm).
  - 2. Fabricate wire ties from 0.187-inch- (4.76-mm) diameter, hot-dip galvanized-steel wire unless otherwise indicated.
  - 3. Masonry-Veneer Anchors at steel stud backup; Single-Barrel Screw with Double-Pintle Wingnut: Self-drilling, single-barrel screw with thermally resistant wingnut head designed to receive double-pintle wire tie. Screw has a smooth barrel the same thickness as insulation with factory-installed gasketed washer to seal at face of insulation and sheathing.

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- a. Products: Subject to compliance with requirements, provide one of the following:
  - 1) Heckmann Building Products, Inc.: Pos-I-Tie Thermal Clip System.
  - 2) Hohmann & Barnard, Inc.: Thermal 2-Seal Wing Nut Anchor.
- D. 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 0.062-inch- thick, stainless-steel sheet.
- E. Partition Top anchors: 0.105-inch- thick metal plate with 3/8-inch- diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from stainless steel.
- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
  1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch thick.
  2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
  3. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
  4. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees.
  5. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch at exterior face of wall and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
  6. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees.
  7. Metal Sealant Stop: Fabricate from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
  8. Metal Expansion-Joint Strips: Fabricate from stainless steel to shapes indicated.
- B. Flexible Flashing: Use the following unless otherwise indicated:
  1. Stainless Steel Laminated Flashing: Sheet flashing product made with polymeric fabric laminated to Type 304 stainless steel sheet, .010 inch thick.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) Prosoco, Inc.; R-Guard SS ThruWall.
      - 2) STS Coatings, Inc.; Wall Guardian Stainless Steel TWF.
      - 3) TK Products, Inc.; TK TWF.
      - 4) York Manufacturing, Inc.; Multi-Flash SS.
- 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 or flexible flashing with a metal drip edge.
  4. Where flashing is fully concealed, use metal flashing or flexible flashing.

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- D. Solder and Sealants for Sheet Metal Flashings:
  - 1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
- E. 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 EMBEDDED FLASHING MATERIALS

- A. Flexible Flashing: Use the following unless otherwise indicated:
  - 1. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of UV stable thermoplastic vinyl of an overall thickness of not less than 0.040 inch.
    - a. Basis-of-Design Product: Subject to compliance with requirements, provide Mortar Net Solutions; TotalFlash unitized flashing and cavity drainage system or comparable product by one of the following:
      - 1) Advanced Building Products Inc.
      - 2) Hyload, Inc.

## 2.11 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, 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 D 2000, 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, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Weep/Vent Products: Use one of the following unless otherwise indicated:
  - 1. Aluminum Weep Hole/Vent: One-piece, L-shaped units made from sheet aluminum, designed to fit into a head joint and consisting of a vertical channel with louvers stamped in web and with a top flap to keep mortar out of the head joint; painted before installation to comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" in color selected by Architect.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) Hohmann & Barnard, Inc.; #343W - Wilko Weep Hole.
- 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.

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- b. Archovations, Inc.; CavClear Masonry Mat.
  - c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
  - d. Mortar Net USA, Ltd.; Mortar Net.
- 2. Provide one of the following configurations:
  - a. Strips, full-depth of cavity and 10 inches high, with dovetail shaped notches 7 inches deep that prevent clogging with mortar droppings.
  - b. Strips, not less than 3/4 inch thick and 10 inches high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.
  - c. Sheets or strips full depth of cavity and installed to full height of cavity.
  - d. Sheets or strips not less than 3/4 inch thick and installed to full height of cavity with additional strips 4 inches high at weep holes and thick enough to fill entire depth of cavity and prevent weep holes from clogging with mortar.
- F. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
    - b. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
    - c. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

## 2.12 CAVITY-WALL INSULATION

- A. As specified in Division 07 Section "Thermal Insulation".

## 2.13 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, provide products by one of the following:
    - a. Diedrich Technologies, Inc.
    - b. EaCo Chem, Inc.
    - c. ProSoCo, Inc.

## 2.14 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 reinforced masonry, use portland cement-lime mortar.

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4. 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 C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.
  1. For reinforced masonry, use Type S.
  2. For interior non-load-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. Face brick.
- E. Grout for Unit Masonry: Comply with ASTM C 476.
  1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
  2. Proportion grout in accordance with ASTM C 476, Table 1 .
  3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

### 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 work.
  2. Verify that foundations are within tolerances specified.
  3. Verify that reinforcing dowels are properly placed.
- 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.



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### 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 the 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.
  - 1. Mix units from several pallets or cubes as they are placed.
- F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

### 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 or minus 1/4 inch.
  - 2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
  - 3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch 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, or 1/2 inch 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, 1/4 inch in 20 feet, or 1/2 inch maximum.
  - 3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch 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, 1/4 inch in 20 feet, or 1/2 inch maximum.
  - 5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
  - 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.

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7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch 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, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch 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 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 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking 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, and wet brick 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 under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

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- I. Build non-load-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. Secure top of masonry partitions as indicated on the Structural Drawings.
  3. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

### 3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow brick and CMUs as follows:
  1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
  2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
  3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
  4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- 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.
- 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 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.

### 3.6 CAVITY WALLS

- A. Bond wythes of cavity walls together using bonding system indicated on Drawings.
- 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. Apply air / weather barrier to face of backup wythe.
- D. Installing Cavity-Wall Insulation: Refer to Division 07 "Thermal Insulation."

### 3.7 ANCHORED MASONRY VENEERS

- A. Anchor masonry veneers to steel stud backup construction with masonry-veneer anchors to comply with the following requirements:
  - 1. Fasten screw-attached anchors through sheathing to wall framing with metal fasteners of type indicated.
  - 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 16 inches o. c. vertically and horizontally. Install additional anchors within 12 inches (305 mm) of openings.
- B. Provide clean 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.

### 3.8 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
  - 1. Space reinforcement not more than 16 inches o.c.
  - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
  - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
- 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.

### 3.9 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 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 o.c. vertically and 36 inches o.c. horizontally.

### 3.10 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.
- C. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch.
  - 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

### 3.11 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND 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.
- 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 lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
  - 3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
  - 4. 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 079200 "Joint Sealants" for application indicated.
  - 5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
  - 6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.

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7. 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 head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
  1. Use specified weep/vent products to form weep holes.
  2. Space weep holes 24 inches o.c. unless otherwise indicated.
  3. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
- 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, 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 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.

### 3.12 REINFORCED UNIT MASONRY INSTALLATION

- 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 other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- 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 ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

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### 3.13 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: Level B special inspections according to the "International Building Code."
  - 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. Mortar Test: For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.
- E. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

### 3.14 IDENTIFICATION

- A. Identify fire rated walls and partitions and other walls required to have protected openings or penetrations effectively and permanently with signs or stenciling above accessible ceilings, repeated at intervals not exceeding 30 feet measured horizontally along walls and partitions.
- B. Include the following information in lettering not less than 3 inches high with 3/8 inch stroke:
  - 1. "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS."

### 3.15 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.

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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 masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.16 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.
- B. Excess Masonry Waste: Remove excess clean masonry waste, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION



SECTION 042516 - THIN BRICK PANEL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thin Masonry Support System is comprised of:
  - a. Thin Masonry Support Panel
  - b. Construction Adhesive
  - c. Silicone Adhesive and Primer
  - d. Air Vent
  - e. Starter Angle Decorative concrete masonry units.
  - f. Shim
  - g. Universal Corner Support
  - h. Fasteners
  - i. Spacers
  - j. Transition Tape
  - k. Mortar
    - 1) Color Mortar Blend (Portland cement lime mortar)
    - 2) Type N or Type S Preblended Mortar
2. Related Materials and Procedures:
  - a. Thin Brick
  - b. Cleaning
  - c. Embedded Flashing
  - d. Weepholes/Vents
  - e. Movement Joints
  - f. Fasteners
  - g. Silicone Sealant
  - h. Silicone Sealant Primer

1.2 REFERENCES

- A. ANSI A118.4 - American National Standards Institute Specifications for Modified Dry-Set Cement Mortar
- B. ANSI A118.15 - American National Standards Institute Specifications for Improved Modified Dry-Set Cement Mortar
- C. ASTM A 240 - Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
- D. ASTM A 510 - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel

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- E. ASTM A 653 – Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process
- F. ASTM A 925 – Standard Specification for Zinc 5% Aluminum Mischmetal Alloy Coated Steel Overhead Ground Wire Strand
- G. ASTM B 117 – Standard Practice for Operating Salt Spray (Fog) Apparatus
- H. ASTM C 67 – Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
- I. ASTM C 126 – Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units
- J. ASTM C 270 – Standard Specification for Mortar for Unit Masonry
- K. ASTM C 954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
- L. ASTM C 1088 – Standard Specification for Thin Veneer Brick Units Made From Clay or Shale
- M. ASTM C 1364 - Standard Specification for Architectural Cast Stone

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Submit manufacturer's product description, indicating material types and thicknesses and storage and handling requirements.
- B. Shop Drawings: For the following:
  - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
  - 2. Masonry Support Panel: Show layout of panels and accessories.
  - 3. Submit individual drawings to be approved by Architect for special shaped thin veneer units.
- C. Samples for Verification: Submit samples of each product type proposed for use.
- D. Material Certificates: Prior to delivery, submit to Architect/Engineer certificates indicating compliance with the applicable codes, specifications and criteria herein for Thin Brick, including Grade and Type listed in this Section.
- E. Thin Brick Test Reports: Submit test reports substantiating compliance with requirements of ASTM C1088 or ASTM C216 for thin brick cut from facing brick. Sample and test in accordance with ASTM C 67.
  - 1. Testing and reports shall be completed by an independent laboratory.
    - a. Test reports for each type of brick shall be submitted to the Architect/Engineer for review.
    - b. Thin Brick Test reports shall indicate:
      - 1) 5-hour boiling water absorption

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- 2) Saturation coefficient
- 3) Initial rate of absorption
- 4) Efflorescence Rating

- F. Costs of Tests: Cost of tests shall be borne by the purchaser, unless tests indicate that units do not conform to the requirements of the specifications, in which case cost shall be borne by the seller.
- G. Installation Instructions: Submit copy of manufacturer's product installation instructions

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Warranty Documentation:
  - 1. Product warranty documentation specified under Section 3.12 shall be supplied to contractor (for subsequent provision to building owner) upon completion of building construction.
- C. Maintenance:
  - 1. Installer shall supply to contractor (for subsequent provision to building owner) copy of manufacturer's pertinent documentation relating to typical repair of thin veneer system once occupancy commences.

#### 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- B. 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.
- C. 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.
- D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- E. Comply with all applicable codes, regulations, and standards. Where provisions of applicable codes, regulations and standards conflict with requirements of this section, the more demanding shall govern.
- F. Manufacturer Qualifications:
  - 1. Obtain materials from one manufacturer to ensure compatibility.
  - 2. Thin Masonry Support Panel:

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- a. Documented qualifications and capabilities that fully describe the ability to provide the required metal panel system and technical support to the Owner.
  - b. At least five (5) completed projects over the last two years, illustrating system performance equal to or exceeding the criteria listed in this specification.
    - 1) Include the project location, award date, the completion date, the contract value, and the name and telephone number of a person employed by the Owner who has personal knowledge of the manufacturer's contractual and technical performance.
- G. Installer Qualifications:
  1. All products listed in this Section shall be installed by a Thin Masonry Support Panel installer or installer providing proof of a minimum of five years' experience with a related thin masonry support system.
  2. At least one supervisory journeyman, who has completed Thin Masonry Support Panel training, shall be present at all times during execution of work, who shall be thoroughly familiar with design requirements, types of materials being installed, reference standards and other requirements, and who shall direct all Thin Masonry Support Panel related work performed at jobsite.
  3. Upon request, installer shall furnish proof of training/experience documentation that may include the following to Contractor prior to commencement of work under this Section:
    - a. Training certificate from Thin Masonry Support Panel manufacturer.
    - b. Lists of completed projects with project names, addresses, and contact information of architects and owners.
    - c. Specialty certification held by installer that are relevant to this project, including the name of the certification, certifying body, and date certified.
- H. Sample/ Mock-Up Panels: Sample/mock-up panels shall be used to review installation process as well as thin brick and mortar color selections and serves as the standard of workmanship for the Project.
  1. Build mock-up panel for walls to receive thin brick panel system as shown on project drawings.
    - a. All thin brick shipped for the mock-up shall be included in the panel.
    - b. Use mock-up panel as standard of comparison for all masonry work built of same material.
    - c. Where masonry is to match existing, erect panel adjacent and parallel to existing surface.
    - d. Clean one-half of exposed faces of panel with masonry cleaner as indicated and approved by brick manufacturer.
    - e. Approval of panel is for color, texture, and blending of masonry units; relationship of mortar to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
    - f. Protect approved panel from the elements.
    - g. Do not start work until Architect/Engineer/Owner has accepted mock-up panel.
    - h. Do not destroy or move sample or mock-up panels until work is completed and accepted by Architect/Engineer/Owner.
- I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 01041 "Project Coordination Multiple Prime Contracts."

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1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's unopened packaging.
- B. Inspect all materials upon arrival and notify supplier if any damage is observed. Store products in manufacturer's packaging or according to manufacturer's recommendations until ready for installation.
- C. Store Glen-Gery Thin Tech® Panels, masonry units, mortar, and accessories off the ground to prevent contamination by mud, dust or other materials likely to cause staining or other defects.
- D. Protect materials from contamination, moisture, freezing, overheating or other damage in accordance with manufacturer's instructions. Cover all materials with a non-staining waterproof membrane material when necessary to protect from elements.
- E. Store different types of materials separately.
- F. Store adhesive and mortar additive above 32° Fahrenheit and below 86° Fahrenheit temperatures.
- G. Store and dispose of solvent-based materials and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.
- H. Panels must be stored to prevent permanent distortion and kept dry before installation. Panels and accessories should be covered at all times prior to installation.
- I. Dry panels exposed to water or condensation prior to installation or application of thin brick. The presence of moisture on the brick or metal panels may adversely affect adhesive performance.

1.7 PROJECT CONDITIONS

- A. Comply with requirements of referenced standards and recommendations of material manufacturers for environmental conditions before, during and after installation.
- B. Protection of Work:
  - 1. 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 limits.
  - 2. Stain Prevention:
    - a. Prevent adhesive and mortar from staining the face of masonry.
    - b. To avoid smearing of adhesive or mortar on the face of masonry, allow adhesive and mortar on face of installed masonry to become firm before trying to remove.
    - c. Protect all sills, ledges and projections from droppings of adhesive or mortar.
    - d. Protect the wall from rain-splashed mud and mortar splatter.
- C. Cold-Weather Requirements:
  - 1. Do not use frozen materials or materials mixed or coated with ice or frost.

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2. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions.
  3. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
  4. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- D. Hot-Weather Requirements:
1. Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
  2. Protect mortar from uneven and excessive evaporation.
    - a. The face of the installed thin brick may be dampened with water prior to mortar installation to reduce the absorption of moisture from the mortar joint and increase bond.
    - b. Veneer may be fogged with water to prevent drying prior to proper hydration of mortar. Apply only enough moisture to consistently dampen the wall without allowing water to run down the face of the masonry.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

- A. Basis of Design Manufacturer: Glen-Gery Corporation located at 1166 Spring Street, P.O. Box 7001, Wyomissing, PA 19610; Tel: 610-562-3076; Email: [info@glengery.com](mailto:info@glengery.com); Web: [www.glengery.com](http://www.glengery.com)
1. Other manufacturers may bid this project subject to compliance with the performance requirements of this specification and submission of evidence thereof as a substitution request during bidding.

### 2.2 THIN MASONRY VENEER SUPPORT SYSTEM

- A. Thin Masonry Veneer Support Panel: Metal support panel consisting of 26 gauge (16 mil) , stucco embossed, textured steel with angled ties providing structural mechanical support for interior or exterior thin masonry veneer, installed by fastening to concrete, masonry, metal or wood frame construction.
1. All Metal Panels for thin brick support specified and shown on drawings shall be Elite Thin Tech® Panels as manufactured by the Glen-Gery Corporation.
  2. Exterior Finish: G90 Galvanized with thermal set coating.
  3. Support ties: 3/8 in.
  4. Support Panels: 4 ft. x 4 ft. nominal (16 sq. ft, 1.44 m2 - actual dimensions except as noted: 48 in. [W] 47-7/8 in. x [H] 48 in. x [T] 3/8 in.) masonry support panels for flat wall areas, shall be for unit heights as follows:
    - a. 2-5/8 in. (2.667 in., 68 mm) spacing for Modular, Standard, Norman, and other 2-1/4 in. (57 mm) high units. Three (3) courses equal 8 in. (203 mm).

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- B. Fasteners (For Masonry Support Panel)
  - 1. Screw fasteners as supplied by Glen-Gery: Pan head fasteners with a minimum #10, (0.190 in., 4.8 mm) thread diameter and corrosion resistance provided by tri-layered ceramic surface coating with a minimum protection of 1000 hrs. when tested according to ASTM B117.
    - a. Fasteners for attachment to wood studs, concrete and masonry: Self-tapping, point type 17.
    - b. Fasteners for attachment to light gauge steel studs: Self-drilling, with a drilling capacity of 0.035 to 0.176 in. and minimum torsional strength of 75 lb/in.
  - 2. Fastener Length:
    - a. Metal framing/support member fasteners: 3-½ in. (89 mm), 4 1/2 in (114 mm), 5-¾ in. (146 mm). Fasteners shall penetrate not less than member thickness plus three threads (3/16 in., 5 mm).
- C. Starter Angle Flashing:
  - 1. Starter Angle:
    - a. Stainless steel conforming to ASTM A240/A240M, Type 304, 0.018 in. (0.45 mm) (26 gauge) pre-bent in 10 ft. (3.05 m) lengths.
    - b. Depth: 2-1/4 in.
    - c. Profile: 45 degree drip.
- D. Water-Resistive Barrier:
  - 1. Provide water resistive barriers as designated in Division 07.
  - 2. Water resistive barrier shall be Water-resistive barrier complying with ASTM E2556, Type II.
- E. Drainage Mat/Rainscreen shall be:
  - 1. Glen-Gery Drainage Mat
    - a. Filter fabric laminated to spun and heat welded entangled geomatrix, 0.25 in. (6 mm) two-ply polypropylene core mesh with cornrow configuration
    - b. Permits moisture drainage and creates airspace
    - c. Hydraulic Transmissivity, Machine Direction, ASTM D 4716:
      - 1) Flow Rate: 3.70 GPM/ft. width.
      - 2) Transmissivity: 7.65E-03 m2/s.
    - d. Air Transmissivity, ASTM D 4716, Modified:
      - 1) Estimated Flow Rate: 15.8 cu ft./min/ft. width.
      - 2) Incremental Transmissivity: 6.97E-04 m2/s
- F. Shims: 1-¼ in. (32 mm) wide by [H] 48 in. (1,219 mm) by [T] 3/8 in. (10 mm), manufactured from G90 hot dipped galvanized, 26 gauge (16 mil) steel with thermal set coating, stucco embossed texture and centered channel.
- G. Adhesives and Primer
  - 1. Glen-Gery Heavy Duty Construction Adhesive for thin brick (maximum 1 in. [25 mm] thick) as supplied by Glen-Gery:
    - a. High-strength mastic exceeding ASTM D3498 and ASTM C557 specifications with less than 70 grams of VOC per liter with a shear value between the thin veneer and the panel greater than 50 PSI.

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H. Installation Hardware

1. Support Channels: 8 ft. (2.44 m) long, manufactured from 26 gauge (18 mil) stainless steel with ½ in. (13 mm) support leg, ¾ in. (19 mm) wide by ½ in. (13 mm) high clip.
  - a. 3-¾ in. (95 mm) Type 1 Classic Channel for 3-⅝ in. (92 mm) high units

I. Spacer: 1-1/4" in. (31 mm) [H] x 1 in. (25 mm) [W] x 3/4 in. (19 mm) [T] injection molded plastic with height-setting panel clip, reusable.

J. Weepholes/Vents:

1. Air Vent: Impact resistant polypropylene copolymer. Density 2,000 grams/sq. meter. Size: ⅜ in. (10 mm) x ½ in. (13 mm) x 48 in. (1.22 m).

2.3 MASONRY UNITS, GENERAL

A. Masonry unit weight may not exceed 15 psf.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other imperfections exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed work.

2.4 CLAY UNIT MASONRY

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:

1. Provide special shapes for applications where flats (stretcher units) cannot accommodate special conditions, including those at corners and openings.
2. Provide special shapes for applications requiring thin brick of size, form, color and texture on exposed surfaces that cannot be produced by sawing.
3. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view. Thin Brick: Facing thin brick veneer complying with ASTM C 1088, grade exterior.
4. Basis of Design Product:
  - a. Interstate Brick "Mountain Red" field brick and "Canyon Rose", accent brick.
  - b. Modular: 2-1/4 in. (57 mm) high, 7-5/8 in. (194 mm) long
  - c. Thickness: 3/4 in. (19 mm)

2.5 MORTAR AND GROUT MATERIALS

A. Cold Weather Additives (including accelerators) shall not be used in mortar.

B. Mortar for thin brick:

1. Mortar shall conform to ASTM C 270, Standard Specification for Mortar for Unit Masonry.
  - a. Glen-Gery Color Mortar Blend: Color - G (as selected by architect) Type N or S
2. Mortar modified with polymer additives and conforming to ANSI A118.4 or ANSI A118.15 specifications for modified or improved modified dry-set cement mortar.



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## 2.6 ANCILLARY MATERIALS

### A. Flashing

1. Self-Adhering Stainless Steel Fabric Flashing: Composite flashing product consisting of a 0.003 in. (0.08 mm) single sheet of Type 304 stainless steel bonded to a 0.004 in. (0.10 mm) layer of polymeric fabric.
2. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy as follows:
  - a. Monolithic Sheet: Elastomeric thermoplastic flashing, 0.040 in. (1.0 mm) thick.
  - b. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 0.025 in. (0.6 mm) thick, with a 0.015 in. (0.4 mm) thick non-asphaltic adhesive.
3. Butyl Flashing: Self-adhering flashing membrane, minimum 0.016 in. in thickness (0.15 mm) consisting of a polyolefin film and butyl adhesive.
4. Adhesives, Primers, and Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for joints or connections to or between water-resistive barrier or air barrier system components.
  - a. Transition Tape:
    - 1) Asphalt free self-adhering membrane, 3 in. (76 mm) wide, consisting of woven polyethylene/polypropylene film bonded to heavy duty synthetic rubber adhesive.
    - 2) Self-adhering tape, 3 in. (76 mm) wide, consisting of a polyolefin film with an acrylic adhesive.
  - b. Primer: As recommended by the manufacturer of the specified product.

### B. Control and Expansion Joints

1. Bond Breaker Tape: Polyethylene tape, width to match width of movement joint.
2. Backer Rod: Non-gassing polyethylene or flexible polyurethane foam rod 25% wider than width of joint to be filled and depth exceeds requirements in as indicated in Division 07 Section "Joint Sealants".
3. Sealant: As specified in Division 07 Section "Joint Sealants" and complying with ASTM C920.

## 2.7 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. Diedrich Technologies, Inc.
  - a. 202 New Masonry Detergent
  - b. 202V Vana-Stop
  - c. Green Clean 250 Manufactured Stone Cleaner

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## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Do not begin thin brick panel system installation until substrates, water-resistive barrier, drainage mat, foundations, rough-ins and built-in construction have been installed according to project specifications and building code requirements.
  - 1. Walls must be structurally sound and the substrate system designed with a wall deflection not greater than  $L/360$ .
    - a. Maximum wall frame spacing for stud walls = 24 in. (610 mm) O.C.
    - b. Minimum 0.043 in. (18 gauge; 1.09 mm) metal framing for exterior walls.
  - 2. Substrate shall provide continuous support and be flat, with surface variation not exceeding 1/8 in. (3 mm) within any 4 ft. (1.2 m) square area and have no planar irregularities greater than 1/4 in. (6 mm) in 10 ft. (3.05 m).
  - 3. Substrate shall be concrete, masonry or one of the following as deemed suitable for specific project conditions:
    - a. Exterior grade gypsum sheathing not less than 1/2 in. (13 mm) in thickness.
- B. Verify walls are plumb and corners are braced to specifications.
- C. If substrate (including insulation), water-resistive barrier, drainage mat, foundations or flashings (including roof and kickout flashing when applicable) are the responsibility of another installer, notify Architect and General contractor of unsatisfactory preparation before proceeding.
- D. Do not begin installation of thin brick panels until unacceptable conditions have been corrected. Installation constitutes acceptance of existing conditions.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation. All surfaces including, but not limited to metal panel and back face of thin brick must be free of water, snow, dirt, mud, oil and other foreign materials prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Trim or flash in place per manufacturer's details and/or BIA Technical Note 28C on Thin Brick Veneer.
- D. Protect the tops of all uncompleted walls to prevent water entry.

### 3.3 INSTALLATION, GENERAL

- A. Install materials in accordance with manufacturer's instructions.
- B. Select and arrange exposed masonry units to produce a uniform blend of color and texture.

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1. Install masonry units from several pallets or cubes as they are placed.
- C. Comply with tolerance requirements in TMS 602 (ACI 530.1/ASCE 6).

### 3.4 FLASHING

- A. Prior to metal panel installation, install starter angle and flashing in accordance with thin brick panel system manufacturer's installation instructions or ASTM E2112. Prime substrate prior to installation when required by flashing manufacturer.
- B. Seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
- C. Extend horizontal through wall flashing vertically up the backing a minimum of 3 in. (76 mm).
- D. Lap flashing ends a minimum of 3 in. (76 mm).
- E. Seal vertical and horizontal legs of all flashing laps with compatible lap [cement] [sealant].
- F. Lap water-resistive barrier over top of flashing.
- G. Turn up the ends of discontinuous (e.g., head, sill and stepped) flashings to form end dams or extend not less than 4" (102 mm) beyond edges of openings.
- H. Extend flashing through wall with at least 1/4 in. (6 mm) exposed to form a drip.

### 3.5 THIN MASONRY SUPPORT PANEL

- A. Install in accordance with manufacturer's written instructions as applicable to each type of substrate required.
- B. Trim, starter angle and flashing shall be installed prior to panel installation.
- C. Panels shall be clean, dry and free of dirt, oil or any other foreign contaminant.
- D. Attach panels flat to the substrate in true and level rows with support ties aligned and level to each other, including at corners.
- E. Stagger vertical support panel joints over sheathing joints and at least 16 in. (406 mm) horizontally from panels in rows above or below.
- F. Install full-size uncut panels when possible. Cut panels using a method resulting in clean, unbent edges when necessary to provide vertical staggered panel joints, to ensure panels are fastened to studs, or to fit specific conditions.
- G. Install panels with 1/16 in. to 1/8 in. (2 to 3 mm) space between the vertical edges of panels.

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- H. Do not allow panels to bridge vertical or horizontal movement joints in substrate. The space between metal panels at substrate movement joint locations shall be equal to the thickness of the substrate movement joint.
- I. Stop panel at least 3/8 in. (10 mm) from inside corners, openings and other materials to allow for movement.
- J. Start panels at least 4 in. (102 mm) above earth and 2 in. (51 mm) above paved areas. Maintain a minimum clearance of 2 in. (51 mm) above roof surfaces. Do not install Thin Tech® panels below grade.

### 3.6 FASTENERS (For Thin Masonry Support Panel)

- A. Attach fasteners to framing/support members for framed applications. Do not attach thin brick panel system to the sheathing alone.
- B. Fasteners for steel studs or other steel supports shall penetrate a minimum of three threads beyond steel member thickness.
- C. Fastener Installation: Mechanically attach metal panels with a minimum of one fastener per sq. ft. (929 cm<sup>2</sup>), reducing fastener spacing along the top and bottom of the wall and around openings, as indicated below.
  - 1. Spacing of pre-punched fastener holes results in the typical recommended fastener spacing of 8 in. (203 mm) vertically and 16 in. (406 mm) horizontally.
  - 2. Horizontal fastener spacing shall not exceed 24 in. (610 mm); vertical fastener spacing shall not exceed 16 in. (406 mm).
  - 3. Fasteners should not be installed behind masonry units, except where they are placed within the channels of Elite Panels.
  - 4. Provide additional fasteners around the perimeter of walls and around openings larger than 24 in. (610 mm) in either dimension, as well as building corners not utilizing corner panels as follows:
    - a. Fasteners shall be placed within 8 in. (203 mm) of the top and bottom of the building walls, at a maximum spacing of 12 in. (305 mm) horizontally.
    - b. At vertical ends of walls and openings, fasteners shall be spaced a maximum of 8 in. (203 mm) vertically within 4 in. (102 mm) of the vertical edge of the panel.
    - c. Where the vertical edge of Thin Tech® Elite Panel is more than 2 in. (51 mm) from a channel, install Thin Tech® Shim and fasten for additional support.

### 3.7 MASONRY UNITS

- A. Back face of thin brick and surface of metal panel must be dry and clean; free of dirt, oil or and other contaminants.
- B. Prior to installing veneer units with adhesive, establish unit layout to ensure bond patterns with uniform joint thicknesses and to reduce cutting at openings, movement joints, returns, and offsets.
  - 1. Avoid using less-than-half-size units, particularly at corners and jambs.

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2. Avoid using cut units at heads and sills of opening.
  3. Ensure unfinished or cut faces are not exposed to view upon completion.
- C. Lay masonry in bond pattern as indicated on drawings or general notes.
- D. Select and arrange units for exposed unit masonry to produce a uniform blend of color and texture.
- E. Leave a uniform 3/8 in. to 1/2 in. (10 to 13 mm) space around the perimeter of openings to allow for movement joint installation.
- F. Apply 1 in. (25 mm) diameter dabs of specified adhesive, not more than 6 in. (152 mm) apart to the back of thin brick and adhere units to panel. No less than two dabs/beads shall be applied to each full length unit. Corner units shall have at least one dab/bead of adhesive applied to the head/return.
1. Do not apply adhesive in horizontal streams.
  2. Do not use excessive adhesive as this may cause veneer units to tilt away from wall prior to adhesive set.
  3. Do not apply silicone adhesive within 1/2 in. to 1 in. (13 to 25 mm) of any stone edges.
- G. Masonry units shall be adhered to dry panel within 5 to 10 minutes after adhesive has been applied and before film begins to form on the adhesive.
- H. When adjustment is necessary to be made after adhesive begins to harden, remove hardened adhesive and replace with fresh adhesive.
- I. Keep areas intended to receive sealant clear of thin brick, adhesive and other materials during construction.
- J. Do not allow masonry units to bridge movement joints in substrate.

### 3.8 MORTAR INSTALLATION AND JOINTING

- A. After adhesive has set a minimum of 6 hours, completely fill head and bed joints intended to receive mortar.
- B. Discard mortar after two hours or when too stiff to work. Retempering within two hours is permitted, but may contribute to mortar color variation.
- C. Do not fill movement joints to receive sealant.
- D. Do not fill joints to receive Air vent.
- E. Form weep holes (head joints free of mortar) as required in Section 3.9, immediately above starter angles and flashings.
- F. Tool exposed joints when thumbprint hard to joint concave profile.

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- G. Flush cut all joints not tooled.
- H. When repointing, completely remove mortar, and refill solidly with mortar and tool joints.

### 3.9 WEEPHOLES/VENTS

- A. Vents for Elite Panels: Omit mortar from head joints and install vents cut to 2-1/4 in. (57 mm) vertically in head joints.
  - 1. Spacing of weep vents shall not exceed a maximum of 24 in. (610 mm) on center horizontally for units 12 in. (304.8 mm) or less in length and a maximum of 32 in. (813 mm) on center for larger units, in the joint between the flashing and masonry units above or in the lower third of the head joints immediately above the starter angles and flashings, including the base of the wall, at horizontal expansion joints and above all openings.
  - 2. Keep vents free of mortar or other obstructions.

### 3.10 MOVEMENT JOINTS

- A. Locate movement joints where indicated on drawings.
- B. Provide vertical and horizontal movement joints where indicated by leaving a continuous space no less than 3/8 in. (10 mm) wide between Thin Tech® panels, installing bond breaker tape or backer rod as specified and installing sealant as specified in Division 07 Section "Joint Sealants."
  - 1. Provide and install bond breaker tape at movement joints prior to installing masonry units 1 in. (25 mm) or less in thickness. Install backer rod where thickness of masonry unit exceeds 1 in. (25 mm).
- C. Keep entire length of movement joint clear of mortar, adhesive and debris.
- D. Install movement joints between thin brick panel system wall assemblies and other materials, including around windows and doors.
- E. Install movement joints at changes in substrate and where movement joints occur in substrate or foundation.
- F. Install movement joints at changes in wall height or thickness.
- G. Spacing of vertical movement joints must not exceed 24 ft. (7.3 m) on center in walls without openings.
- H. Install movement joints at inside corners and within 2 to 4 ft. (0.6 to 1.2 m) of outside corners where intersecting walls (with Thin Tech® applied to each) are longer than 4 ft. (1.2 m).
- I. Install no less than one horizontal movement joint per story, with height between horizontal movement joints not exceeding 20 ft. (6.1 m).
- J. Install horizontal movement joints below all starter angles above the base of the wall.

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3.11 CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses with a dry, non-metallic brush to remove adhesive as well as mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is set and cured, clean exposed masonry as follows:
  - 1. Cut out all defective mortar joints and holes in exposed masonry and fill with new mortar.
  - 2. Clean preselected sample wall area with specified cleaning product as per brick manufacturer's recommendations. Do not use muriatic or hydrofluoric acid. Do not proceed with cleaning until approved by Architect/Owner.
  - 3. Clean thin brick in accordance with cleaning product manufacturer's written instructions.
  - 4. Protect adjacent stone and non-masonry surfaces from contact with cleaner.

3.12 WARRANTY

- A. Provide manufacturer's 25 year warranty against material defects in thin brick panels and accessories.
- B. Warranty provides for the original purchaser. See warranty for detailed information on terms, conditions and limitations.

END OF SECTION

SECTION 050513 – FACTORY APPLIED COATING FOR METAL

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies factory-applied metal coatings including the following:
  - 1. The basis of design is Colorgalv® Thermoset - Hot-dip galvanizing, factory-applied polyamide epoxy powder prime coat and Super Durable urethane powder topcoat for iron and steel fabrications. This system meets or exceeds the performance criteria for the AMMA 2003 and AMMA 2004 specifications.

1.2 RELATED SECTION

- A. Examine Contract Documents for requirements that affect Work of this Section. Other Specification Sections that directly relate to Work of this Section include, but are not limited to:
  - 1. Section 051200 - Structural Steel Framing.

1.3 SUBMITTALS

- A. Product Literature for Factory-Applied Metal Coatings: Submit galvanizer's product data sheets for coatings specified in this Section including physical performance test data.
- B. Certificate of Compliance for Items Coated by Galvanizer: Submit notarized Certificate of Compliance, signed by the galvanizer, indicating compliance with requirements of specifications.
- C. Substitutions: Substitutions must be submitted with performance criteria that meet or exceed the requirements of this specification.
- D. Certification from the American Galvanizers Association that Galvanizer has a certified Master Galvanizer on staff.
- E. Certificate of Compliance for Shop Application: The galvanizer/applicator shall be SSPC-QP3 certified.

1.4 QUALITY ASSURANCE

- A. Galvanizer's Qualifications: Galvanizer must have a minimum of ten years of experience in hot-dip galvanizing using the dry kettle process and the application of the coatings required in this specification. The coating application must be performed in the same facility as the galvanizing.
- B. Coordination between Fabricator and Galvanizer: The galvanizer shall review fabricator's shop drawings for suitability of materials for galvanizing and coatings and will notify the fabricator of any required modifications.
- C. Coating Applicator: For the purpose of establishing a standard of quality, appearance and performance of the finished product, the finish provide by the coating applicator must be equal to or better than the finish provided by Duncan Galvanizing.

PART 2 PRODUCTS



## 2.1 SECTION INCLUDES

A. Hot-Dip Galvanizing: For steel exposed to the elements, weather or corrosive environments and other steel indicated to be galvanized, provide coating for iron and steel fabrications applied by the hot-dip process. Galvanizing bath shall contain special high-grade zinc.

1. Basis of design: Duragalv®
2. Comply with ASTM A 123 for fabricated products and ASTM A 153 for hardware.
3. If required, plug vent holes after galvanizing and grind smooth.
4. Galvanized surface shall be prepared per SSPC SP2 or SP3 to provide a smooth surface removing all runs, drips or sags.
5. Galvanizing shall exhibit a rugosity (smoothness) of 16-25 microns or less when measured by a profilometer. This pertains to those elements that are less than 24 pounds per running foot.
6. Galvanized surfaces, that are to receive coatings, must be blasted per SSPC SP 16. The use of iron, steel shot, and aluminum oxide grit as a blast medium, and power wire brushes are not permitted.

B. Primer: Provide factory-applied polyamide powder epoxy prime coat over metal that has been sandblasted per SSPC SP16.

1. Basis of design: Duncan® Thermoset.
2. Primer shall be a polyamide epoxy powder primer with 0 VOC.
3. Apply primer within 12 hours after blasting at the same plant in a controlled environment meeting applicable environmental conditions and as recommended by the primer coating manufacturer. Cure schedule shall be as recommended by the manufacturer.
4. Primer shall be applied at 1.8-3 mils DFT and certified OTC/VOC compliant and conform to EPA and local requirements.
5. Primer shall meet or exceed the following performance criteria as stipulated by the coating manufacturer:
  - a. Cure Schedule: 10 min. at 400°F
  - b. Specific Gravity: 1.58 +/- .05 1.4-1.7 +/- .05
  - c. Coverage at 1.0 Mil 121.7 sq. ft./ lb.
  - d. 60° Gloss: 55-65 (ASTM D-523)
  - e. Adhesion: 5B (ASTM D-3359)
  - f. Flexibility: Pass 1/8 " Mandrel Bend (ASTM D-522)
  - g. Pencil Hardness: 2H-3H (ASTM D-3363)
  - h. Impact Resistance: 80 in-lbs direct (ASTM D-2794) 80 in-lb reverse
  - i. Typical Environmental Properties: On Bonderite 1000 Panels
  - j. Salt Fog 1000 hours (ASTM B-117)

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- k. Salt Fog (top-coated)\* 5000+ hours (ASTM B-117)
- l. Humidity 1000 hours PASSED

C. Topcoat: Provide factory applied Super Durable powder urethane topcoat in specified color and gloss range per approved samples.

- 1. Topcoat shall be applied over primer per the manufacturer's recoat schedule at the same galvanizer's plant in a controlled environment meeting applicable environmental conditions as recommended by the coating manufacturer. Cure schedule shall be as recommended by the manufacturer.
- 2. Topcoat shall be applied at 1.8-3 mils DFT and certified OTC/VOC compliant and conform to EPA and local requirements.
- 3. Topcoat shall meet or exceed the following performance criteria as stipulated by the coating manufacturer:

- a. Specific Gravity: 1.58 +/- .05
- b. Coverage at 1.0 Mil 121.7 sq. ft./ lb.
- c. 60° Gloss: 55-65 (ASTM D-523)
- d. Adhesion: 5B (ASTM D-3359)
- e. Flexibility: Pass 1/8 " Mandrel Bend (ASTM D-522)
- f. Pencil Hardness: 2H-3H (ASTM D-3363)
- g. Impact Resistance: 80 in-lbs direct (ASTM D-2794) 80 in-lb reverse
- h. Typical Environmental Properties: On Bonderite 1000 Panels
- i. Salt Fog 1000 hours (ASTM B-117)
- j. Salt Fog (top-coated)\* 5000+ hours (ASTM B-117)
- k. Humidity 1000 hours PAST

B. Warranty:

- 1. Provide galvanizer's warranty that materials will be free from 10 percent or more visible rust for 20 years.

PART 3 EXECUTION

3.1 APPLICATION OF FACTORY APPLIED METAL COATINGS

- A. Galvanizing Application: Galvanize materials in accordance with specified standards and this specification. The dry kettle process shall be used to eliminate any flux inclusions on the surface of the galvanized material. The use of the wet kettle process is prohibited.
- B. Prior to Galvanizing: The steel shall be immersed in a flux solution (zinc ammonium chloride). The flux tank must be 12 to 14 Baumé density and contain less than 0.4 percent iron.
  - 1. To provide the galvanized surface required, the following procedures shall be implemented:
    - a. A monitoring recorder shall be utilized and inspected regularly to observe any variances in the galvanizing bath temperature.
    - b. The pickling tanks shall contain hydrochloric acid with an iron content less than 12 percent and zinc content less than 3 percent. Titrations shall be taken weekly at a minimum.
    - c. All chemicals and zinc shall be tested at least once a week to determine compliance with ASTM standards. All testing shall be done using atomic absorp

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tion spectrometry or x-ray fluorescence (XRF) equipment at a lab in the galvanizing facility.

C. Coatings shall be applied under the following conditions:

1. Surface of the substrate shall be dry and free from dust, dirt, oil, grease or other contaminants. Coating and cure facility shall be maintained free of airborne dust and dirt until coatings are completely cured.
2. All coatings must be applied in a controlled environment under the conditions specified by the coating manufacturer. All coatings must be mixed and applied according to the coating manufacturer's specifications.

### 3.2 INSTALLATION

- A. Installation: Comply with fabricator's and galvanizer's requirements for installation of materials and fabrications, including use of nylon slings or padded cables for handling factory-coated materials.
- B. Touch-Up and Repair: For damaged and field-welded metal coated surfaces, clean welds, bolted connections and abraded areas the following procedures must be used.
  1. For galvanized surfaces, apply organic zinc repair paint complying with requirements of ASTM A 780, modified to 95 percent zinc in dry film. Galvanizing repair paint shall have 95 percent zinc by weight. Basis of design is ZIRP by Duncan Galvanizing. Thickness of applied galvanizing repair paint shall be not less than coating thickness required by ASTM A 123 or A 153 as applicable.
  2. For factory-applied finish coatings, field-touch-up shall be performed by qualified applicators with experience in the application of high-performance industrial coatings. All coating manufacturer's requirements for mixing, application and environmental conditions must be followed. Touch-up shall be performed so that the repair is not visible from a distance of 6 feet. A touch-up repair kit and repair procedures shall be provided to the Owner for each type of factory-applied finish upon request.

END OF SECTION

## **SECTION 051200 - 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.
  - 3. Shear stud connectors.
- B. Related Requirements:
  - 1. Section 05 12 13 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
  - 2. Section 05 50 00 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other steel items not defined as structural steel.

#### **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.

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## 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. Etching cleaner.
8. Galvanized repair paint.
9. 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 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 qualified by testing.

## 1.7 INFORMATIONAL SUBMITTALS

### A. Qualification Data: For fabricator.

### B. Welding certificates.

### C. Survey of existing conditions.

### D. Source quality-control reports.

### E. Field quality-control reports.

## 1.8 QUALITY ASSURANCE

### A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU.

### B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

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- C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

#### 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 360.
  - 3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
  - 1. Fabricator's experienced steel detailer shall select or complete connections in accordance with ANSI/AISC 303.
    - a. Select and complete connections using schematic details indicated, and ANSI/AISC 360.
    - b. Use Allowable Stress Design; data are given at service-load level.
- C. Moment Connections: Type FR, fully restrained.

#### 2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M, Grade 50.

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- B. Channels and Angles, ASTM A36/A36M.
- C. Plate and Bar: ASTM A36/A36M.
- D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.
- E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.
  - 1. Weight Class: As indicated.
- F. Welding Electrodes: Comply with AWS requirements.

## 2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, 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, compressible-washer type with plain finish.
- B. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
  - 1. Finish: Hot-dip zinc coating.
- C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
  - 1. Finish: Plain.
- D. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

## 2.4 RODS

- A. Unheaded Anchor Rods: ASTM F1554, Grade 36.
  - 1. Nuts: ASTM A563 heavy-hex carbon steel.
  - 2. Plate Washers: ASTM A36/A36M carbon steel.
  - 3. Washers: ASTM F436, Type 1, hardened carbon steel.
  - 4. Finish: Plain, unless noted otherwise.
- B. Headed Anchor Rods: ASTM F1554, Grade 36, straight.
  - 1. Nuts: ASTM A563 heavy-hex carbon steel.

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2. Plate Washers: ASTM A36/A36M carbon steel.
3. Washers: ASTM F436, Type 1, hardened carbon steel.
4. Finish: Plain, unless noted otherwise.

C. Threaded Rods: ASTM A36/A36M.

1. Nuts: ASTM A563 heavy-hex carbon steel.
2. Washers: ASTM F436, Type 1, hardened.
3. Finish: Plain, unless noted otherwise.

2.5 PRIMER

A. Steel Primer:

1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.6 SHRINKAGE-RESISTANT GROUT

- A. 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. Mark and match-mark materials for field assembly.
4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

- B. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

- C. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

- D. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

- E. 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.
2. Baseplate Holes: Cut, drill, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.



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## 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: Snug tightened, Pretensioned, or Slip critical, as indicated on the drawings..
- 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 shelf angles located in exterior walls, and as noted on drawings.

## 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.
  - 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.
- 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 2, "Hand Tool Cleaning."
  - 2. SSPC-SP 3. "Power Tool Cleaning"
- C. Surface Preparation of Galvanized Steel: Where indicated, 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.
- 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. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

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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. Fabricator to be AISC Certified and provide Quality Control in accordance with AISC 360 Chapter N.
- B. Testing Agency: If Quality control issues arise with steel delivered to the site, the Owner may engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
  1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- C. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

## 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 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.

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1. Set plates for structural members on wedges, shims, or setting nuts as required.
  2. 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.
  3. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. 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. Slope roof framing members to slopes indicated on Drawings.
  2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection.
- G. 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: Snug tightened, Pretensioned, or Slip critical as indicated.
- 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 where indicated, 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 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:

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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: Owner will 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.
    - b. Testing Agency shall ultrasonically inspect all complete-penetration welds in accordance with ASTM E164.
- C. Correct deficiencies in Work that test reports and inspections indicate does not comply with requirements.

**END OF SECTION 05 12 00**

## **SECTION 051213 - ARCHITECTURALLY EXPOSED 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. Architecturally exposed structural steel (AESS).
  - 2. Section 05 12 00 "Structural Steel Framing" requirements that also apply to AESS.
- B. Related Requirements:
  - 1. Section 099110 "Painting" for surface preparation and priming requirements.

#### **1.3 DEFINITIONS**

- A. AESS: Architecturally exposed structural steel.
- B. SEAC/RMSCA Guide Specification: SEAC/RMSCA's "Sample Specification, Section 05 02 13: Architecturally Exposed Structural Steel."

#### **1.4 COORDINATION**

- A. Coordinate surface preparation requirements for shop-primed items.
- B. 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.

#### **1.5 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.

#### **1.6 ACTION SUBMITTALS**

- A. Product Data:
  - 1. Tension-control, high-strength, bolt-nut-washer assemblies.
  - 2. Filler.

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3. Primer.

B. Shop Drawings: Show fabrication of AEES components. Shop Drawings for structural steel may be used for AEES.

1. Identify AEES category for each steel member and connection, including transitions between AEES and non-AEES.
2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
3. Indicate orientation of mill marks and HSS seams.
4. 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. Indicate grinding, finish, and profile of welds.
5. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections. Indicate orientation and location of bolt heads.
6. Indicate exposed surfaces and edges and surface preparation being used.
7. Indicate special tolerances and erection requirements.
8. Indicate weep holes for HSS.
9. Indicate surface preparation, primer, and coating requirements, including systems specified in other Sections.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator and shop-painting applicator.
- B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172) and is experienced in fabricating AEES similar to that indicated on this Project.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Use special care in handling AEES to prevent twisting, warping, nicking, and other damage during fabrication, delivery, and erection. Store materials to permit easy access for inspection and identification. Keep AEES members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect AEES members and packaged materials from corrosion and deterioration.
  1. Do not store AEES 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.

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1.10 FIELD CONDITIONS

- A. Field Measurements: Where AEES is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with requirements of ANSI/AISC 303, Sections 1 through 9 and as modified in Section 10, "Architecturally Exposed Structural Steel."

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. Tension-Control, High-Strength, Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, round-head assemblies consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
  - 1. Finish: Plain.

2.3 FILLER

- A. Polyester filler intended for use in repairing dents in automobile bodies.

2.4 EXTERIOR COATING SYSTEM

- A. Primer: Organic Zinc-Rich Epoxy Primer.
  - 1. Basis of Design: Carboline; Carbozinc 859.
  - 2. Dry Film Thickness: 5 mils.
- B. Top Coat: Modified Siloxane Hybrid Coating; High-build, high-solids, isocyanate-free.
  - 1. Basis of Design: Carboline; Carboxane 2000.
  - 2. Dry Film Thickness: 5 mils.

2.5 PRIMER

- A. Steel Primer:
  - 1. Comply with Section 09 91 13 "Exterior Painting" and Section 09 91 10 "Painting."
  - 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: MPI#26.

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1. Etching Cleaner: MPI#25, for galvanized steel.
2. Galvanizing Repair Paint: ASTM A780/A780M.

## 2.6 FABRICATION

- A. Shop fabricate and assemble AECS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.

1. Use special care handling and fabricating AECS before and after shop painting to minimize damage to shop finish.

B. Category AECS 3:

1. Comply with overall profile dimensions of AWS D1.1/D1.1M for welded built-up members. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
2. Prepare surfaces according to Part 2 "Shop Priming" Article and SSPC-SP 6 (WAB)/NACE WAB-3.
3. Grind sheared, punched, and flame-cut edges to remove burrs and provide smooth surfaces and eased edges.
4. Make intermittent welds appear continuous, using filler or additional welding.
5. Seal weld open ends of hollow structural sections with 3/8-inch closure plates, or as indicated.
6. Limit butt and plug weld projections to 1/16 inch.
7. Install bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
8. Remove weld spatter, slivers, and similar surface discontinuities.
9. Remove blemishes and surface irregularities resulting from temporary braces or fixtures by filling or grinding, before cleaning, treating, and shop priming.
10. Grind tack welds smooth unless incorporated into final welds.
11. Remove backing and runoff tabs, and grind welds smooth.
12. Limit as-fabricated straightness tolerance to one-half that permitted for structural-steel materials in ANSI/AISC 303.
13. Limit as-fabricated curved structural steel tolerance to that permitted for structural-steel materials in ANSI/AISC 303.
14. Limit as-fabricated straightness tolerance of welded built-up members to one-half that permitted by AWS D1.1/D1.1M.
15. Conceal fabrication and erection markings from view in the completed structure.
16. Make welds uniform and smooth.
17. Cut out mill marks from mill material or hide these markings from view in the completed structure. Where neither method is possible, remove mill marks by grinding and filling surfaces as approved by Architect.
18. Grind butt and plug welds smooth or fill, removing weld splatter exposed to view.
19. Orient HSS seams as indicated or away from view.
20. Align and match abutting member cross sections.
21. At visible open joints of copes, miters, and cuts, maintain uniform clear gaps of 1/8 inch. At closed joints, maintain uniform contact within 1/16 inch.



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22. Fabricate with exposed surfaces smooth, square, and of surface quality approved by Architect.

## 2.7 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to 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 and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

## 2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A123/A123M.

1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
2. 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.

## 2.9 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:

1. Galvanized surfaces unless indicated to be painted.

- B. Surface Preparation: Clean nongalvanized surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 6 Commercial Blast Cleaning

- C. Preparing Galvanized Steel for Shop Priming: After galvanizing, thoroughly clean steel of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner or according to SSPC-SP 16.

- D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and eased 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.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify, with 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 bearing surfaces, anchor rods, bearing plates, and other embedments, showing dimensions, locations, angles, and elevations.
- B. Examine AECS for twists, kinks, warping, gouges, and other imperfections before erecting.
- C. 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 AECS 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.

#### **3.3 ERECTION**

- A. Take special care during erection to avoid marking or distorting the AECS and to minimize damage to shop painting. Set AECS accurately in locations and to elevations indicated and according to ANSI/AISC 303 and ANSI/AISC 360.
  - 1. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Take care to avoid any blemishes, holes, or unsightly surfaces resulting from the use or removal of temporary elements.
  - 2. Grind tack welds smooth.
  - 3. Remove backing and runoff tabs, and grind welds smooth.
  - 4. Orient bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
  - 5. Conceal fabrication and erection markings from view in the completed structure.
- B. In addition to ANSI/AISC 303, Section 10 requirements, comply with the following.
  - 1. Erection of Category AECS 3:
    - a. Erect AECS to the standard frame tolerances specified in ANSI/AISC 303 for non-AECS.
    - b. Comply with AWS D1.1/D1.1M. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
    - c. Remove weld spatter, slivers, and similar surface discontinuities.
    - d. Grind off butt and plug weld projections larger than 1/16 inch.
    - e. Continuous welds shall be of uniform size and profile.

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- f. Ream holes that must be enlarged. Use of drift pins or burning is not permitted. Replace misaligned connection plates where holes cannot be aligned with acceptable appearance.
- g. Splice members only where indicated on Drawings.
- h. No torch cutting or field fabrication is permitted.
- i. Weld profiles, quality, and finish shall be as approved by Architect.
- j. Make joint welds, including tack welds, appear continuous by filling intermittent welds.

### 3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to 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 and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

### 3.5 REPAIR

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and touchup galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting:
  - 1. 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 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.
  - 2. Cleaning and touchup painting are specified in Section 09 91 10 "Painting."
- C. Touchup Priming: Cleaning and touchup priming are specified in Section 09 96 00 "High-Performance Coatings."

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to inspect AESS as specified in Section 05 12 00 "Structural Steel Framing." The testing agency is not responsible for enforcing requirements relating to aesthetic effect.
- B. Architect will observe AESS in place to determine acceptability relating to aesthetic effect.

**END OF SECTION 051213**

## **SECTION 05 21 00 - STEEL JOIST 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. K-series steel joists.
  - 2. KCS-type K-series steel joists.
  - 3. K-series steel joist substitutes.
  - 4. LH-series long-span steel joists.
  - 5. Steel joist accessories.

- B. Related Requirements:

- 1. Section 04 20 00 "Unit Masonry" for installing bearing plates in unit masonry.

#### **1.3 DEFINITIONS**

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of joist, accessory, and product.

- B. Shop Drawings:

- 1. Include layout, designation, number, type, location, and spacing of joists.
  - 2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
  - 3. Indicate locations and details of bearing plates to be embedded in other construction.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.
- B. Manufacturer certificates.

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C. Mill Certificates: For each type of bolt.

D. Field quality-control reports.

#### 1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

#### 1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

#### 1.8 SEQUENCING

A. Deliver steel bearing plates to be built into cast-in-place concrete and masonry construction.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

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. Canam Steel corporation; Canam Group, Inc.
2. CMC Joist & Deck.
3. New Millennium Building Systems, LLC.
4. Vulcraft; Nucor Vulcraft Group.

#### 2.2 STEEL JOISTS

A. K-Series Steel Joist: Manufactured steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.

1. Joist Type: K-series steel joists and KCS-type K-series steel joists.

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2. K-Series Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
  3. Provide holes in chord members for connecting and securing other construction to joists.
  4. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated on Drawings, complying with SJI's "Specifications."
  5. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated on Drawings, complying with SJI's "Specifications."
  6. Camber joists according to SJI's "Specifications."
  7. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.
- B. Long-Span Steel Joist: Manufactured steel joists according to "Standard Specification for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated on Drawings.
1. Joist Type: LH-series long-span steel joists.
  2. End Arrangement: Underslung.
  3. Top-Chord Arrangement: Parallel.
  4. Camber long-span steel joists according to SJI's "Specifications."
  5. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

## 2.3 PRIMERS

- A. Primer:
1. SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

## 2.4 STEEL JOIST ACCESSORIES

- A. Bridging:
1. Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
  2. Fabricate as indicated on Drawings and according to SJI's "Specifications." Furnish additional erection bridging if required for stability.
- B. Steel bearing plates with integral anchorages are specified in Section 05 50 00 "Metal Fabrications."
- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

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1. Finish: Plain.

D. Welding Electrodes: Comply with AWS standards.

E. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

## 2.5 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

B. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, 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 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written instructions, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.

C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using carbon-steel bolts.



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- E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

### 3.3 REPAIRS

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.
- B. Touchup Painting:
  - 1. Immediately after installation, clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, and accessories.
    - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
    - b. Apply a compatible primer of same type as primer used on adjacent surfaces.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Visually inspect field welds according to AWS D1.1/D1.1M.
  - 1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, at testing agency's option:
    - a. Liquid Penetrant Inspection: ASTM E165/E165M.
    - b. Magnetic Particle Inspection: ASTM E709.
    - c. Ultrasonic Testing: ASTM E164.
    - d. Radiographic Testing: ASTM E94.
- C. Visually inspect bolted connections.
- D. Prepare test and inspection reports.
- E. Contractor to correct deficiencies in Work that testing and inspection reports have indicated are not in compliance with specified requirements.

**END OF SECTION 05 21 00**

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## **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.
  - 2. Acoustical roof deck.
  - 3. Noncomposite form deck.

- B. Related Requirements:

- 1. Section 03 30 00 "Cast-in-Place Concrete" for normal-weight structural concrete fill over steel deck.
  - 2. Section 05 12 00 "Structural Steel Framing" for shop- and field-welded shear connectors.
  - 3. Section 05 50 00 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
  - 4. Section 09 91 10 "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.
  - 2. Acoustical roof deck.
  - 3. Noncomposite form 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.

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- 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."
- C. FM Approvals' RoofNav Listing: Provide steel roof deck evaluated by FM Approvals and listed in its RoofNav for Class 1 fire rating and Class 1-90 windstorm ratings. Identify materials with FM Approvals Certification markings.

#### 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.

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## 2.2 ROOF DECK

- 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. Canam Steel Corporation; Canam Group, Inc.
  - 2. CMC Joist & Deck.
  - 3. New Millennium building Systems, LLC.
  - 4. Nucor Corp.
- B. 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. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), G60 zinc coating.
  - 2. Deck Profile: As indicated on the Drawings.
  - 3. Profile Depth: 1-1/2 inches.
  - 4. Design Uncoated-Steel Thickness: As indicated on the Drawings.
  - 5. Span Condition: Triple span or more.
  - 6. Side Laps: Overlapped.

## 2.3 ACOUSTICAL ROOF DECK

- A. Manufacturers: Subject to compliance with requirements provide the following:
  - 1. Epic Metals Corp
    - a. Gym: Epicore ER3.5A.
  - 2. New Millennium Building Systems, LLC.
    - a. Gym: Versa-Dek 3.5 LS Acoustical.
- B. Acoustical 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. Galvanized and Shop-Primed Steel Sheet: ASTM A653/A653M, Structural Steel (SS), G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
  - 2. Finish: Paint all exposed decking.
    - a. Comply with requirements of Division 09 Section "Painting".
    - b. Refer to Division 09 Section "Color Schedule" for paint colors.
  - 3. Deck Profile: As indicated by manufacturer's designation.
  - 4. Profile Depth: As indicated.
  - 5. Design Uncoated-Steel Thickness: As indicated.
  - 6. Span Condition: As indicated.
  - 7. Side Laps: Overlapped.
  - 8. Acoustical Perforations: Deck units with manufacturer's standard perforations.

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9. Sound-Absorbing Insulation: Manufacturer's standard premolded roll or strip of glass or mineral fiber.
10. Acoustical Performance:
  - a. NRC 0.90 tested according to ASTM C423.
  - b. Meet BOTH the minimum NRC and the minimum absorption coefficients. The recommended minimum absorption coefficients are as follows:

<i>Octave Band Center Frequency</i>	<i>125</i>	<i>250</i>	<i>500</i>	<i>1000</i>	<i>2000</i>	<i>4000</i>
Minimum Absorption Coefficient	0.30	0.75	0.90	0.90	0.85	0.70

## 2.4 NONCOMPOSITE FORM DECK

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into Work include, but are not limited to, the following:
  1. Canam Steel Corporation; Canam Group, Inc.
  2. New Millennium Building Systems, LLC.
  3. Nucor Corp.; Vulcraft Group.
- B. Noncomposite Form Deck: Fabricate ribbed-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
  1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33 zinc coating.
  2. Profile Depth: 1 inch.
  3. Design Uncoated-Steel Thickness: As indicated on the Drawings.
  4. Span Condition: Triple span or more.
  5. Side Laps: Overlapped or interlocking seam at Contractor's option.

## 2.5 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 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, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

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- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated or as recommended by SDI Publication No. 31 for overhang and slab depth where not indicated.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Galvanizing Repair Paint: ASTM A780/A780M, SSPC-Paint 20, or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.
- I. 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.
- 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 if calculations are provided that demonstrate equivalent strength and stiffness to attachment shown on the Structural

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Drawings. 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 long, and as follows:
  - 1. Weld Diameter: As indicated on the Drawings.
  - 2. Welds 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 on the Drawings.
- 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 36 inches, unless closer spacing is indicated, and as follows:
  - 1. Mechanically fasten side laps with self-drilling, No. 10 diameter or larger, carbon-steel screws.
  - 2. Welds at perimeter with 5/8 inch diameter welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
  - 1. End Joints: Lapped 2 inches minimum.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches apart with at least one weld at each corner.
- 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. Sound-Absorbing Insulation: Installation into topside ribs of deck as specified in Section 72100 Thermal Insulation.

### 3.4 INSTALLATION OF FLOOR DECK

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
  - 1. Weld Diameter: 5/8 inch, nominal.
  - 2. Weld Spacing: Space and locate welds as indicated.

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- 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 36 inches, and as follows:
  - 1. Mechanically fasten with self-drilling, No. 10 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, with end joints as follows:
  - 1. End Joints: Butted.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

### 3.5 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 brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 09 91 10 "Painting".

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Field welds and mechanical fasteners 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. Exterior non-load-bearing wall framing.
  - 2. Exterior cladding attachment wall furring.
  - 3. 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 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. Exterior non-load-bearing wall framing.
  - 3. Vertical deflection clips.
  - 4. Single deflection track.
  - 5. Soffit framing.
  - 6. Post-installed anchors.
  - 7. Power-actuated anchors.
- 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.

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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, including attachment to Main Structure.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of code-compliance certification for studs and tracks.
- C. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.
  1. Steel sheet.
  2. Expansion anchors.
  3. Power-actuated anchors.
  4. Mechanical fasteners.
  5. Vertical deflection clips.
  6. Miscellaneous structural clips and accessories.
- 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.

## 1.6 QUALITY ASSURANCE

- A. 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.
- B. 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."

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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1. ClarkDietrich Building Systems.
2. MarinoWARE.
3. Nuconsteel; a Nucor Company.
4. Steel Network, Inc. (the).
5. Super Stud Building Products, Inc.
6. Telling Industries, LLC.
7. United Metal Products.

## 2.2 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 for non masonry finish: 1/600 of the wall height for masonry veneer.
    - b. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height for non masonry finish: 1/600 of the wall height for masonry veneer.
    - c. Soffit 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.
  4. 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.
- D. 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 acceptable to authorities having jurisdiction.

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## 2.3 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.
- B. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
  - 1. Grade: As required by structural performance.
  - 2. Coating: G60.

## 2.4 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: 0.0329 inch at non masonry finish; 0.0428 inch at masonry veneer.
  - 2. Flange Width: 1-5/8 inches.
- 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.
- 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.
  - 1. Manufacturer's: Subject to compliance with requirements, provide product by one of the following:
    - a. Dietrich Metal Framing: a Worthington Industries Company.
    - b. MarinoWare, a division of Ware Industries.
    - c. The Steel Network, Inc.
- 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: 0.0428 inch.
  - 2. Flange Width: 1 inch plus the design gap for one-story structures.

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## 2.5 EXTERIOR WALL CLADDING ATTACHMENT FURRING

- A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
  - 1. Grade: As indicated.
  - 2. Coating: G90.
- B. Steel Furring: Manufacturer's standard hat-shaped channels of web depths indicated and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0428 inch.
  - 2. Section Properties: As required by design criteria.
- C. Delegated Design: Coordinate furring design with proposed cladding materials, substrates, foam insulation thickness, and wind loads as indicated.

## 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: 0.0329 inch.
  - 2. Flange Width: 1-5/8 inches, minimum.

## 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.

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- 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, Torque-controlled adhesive anchor, or adhesive anchor.
  - 3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
  - 4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.
- 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, or SSPC-Paint 20.
- 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.

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## 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 and as follows:
  - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch 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.

## 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.

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- 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.

### 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.
- 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.



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- 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 maximum.
- 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, or
  2. Connect vertical deflection clips to bypassing studs 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 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 12 inches 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 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 and as follows:

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1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.6 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.

### 3.7 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.

### 3.8 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**

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SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Steel framing and supports for ceiling-hung toilet compartments.
  - 2. Steel framing and supports for countertops.
  - 3. Steel framing and supports for mechanical and electrical equipment.
  - 4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
  - 5. Shelf angles.
  - 6. Metal ladders at roof.
  - 7. Miscellaneous steel trim.
- 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.

1.2 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 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.

1.3 ACTION SUBMITTALS

- A. 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 ceiling-hung toilet compartments.
  - 2. Steel framing and supports for countertops.
  - 3. Steel framing and supports for mechanical and electrical equipment.
  - 4. Steel framing and supports for applications where framing and supports are not specified in other Sections.

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5. Shelf angles.
6. Metal ladders.
7. Miscellaneous steel trim.
8. Loose steel lintels.

- B. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.
- B. Welding certificates.
- C. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

#### 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  2. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

#### 1.6 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 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.
- B. 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, ambient; 180 deg F, material surfaces.

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## 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 A 36/A 36M.
- C. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.
- D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- E. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- F. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- G. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

## 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 B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and flat washers where indicated.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.
- D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.
- E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; 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: 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/E 488M, conducted by a qualified independent testing agency.
- G. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

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- H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

## 2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 099000 "Painting and Coating."
- B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- 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. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

## 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.

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- 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. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with primer specified in Section 099000 "Painting and Coating." where indicated.

## 2.7 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.
  - 1. Provide mitered and welded units at corners.
  - 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize and prime shelf angles located in exterior walls.
- D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

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## 2.8 METAL LADDERS

### A. General:

1. Comply with ANSI A14.3.

### B. Steel Ladders:

1. Space siderails 16 inches apart unless otherwise indicated.
2. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 3/4-inch- 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.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) Harsco Industrial IKG, a division of Harsco Corporation; Mebac.
    - 2) SlipNOT Metal Safety Flooring, a division of W. S. Molnar Company; SlipNOT.
7. 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 in least dimension.
8. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
9. Galvanize exterior ladders, including brackets.
10. Prime exterior ladders, including brackets and fasteners, with primer specified in Section 099000 "Painting and Coating."

## 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 miscellaneous steel trim.
- D. Prime exterior miscellaneous steel trim with primer specified in Section 099000 "Painting and Coating."



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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 that are not within the building's exterior envelope.

2.11 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches unless otherwise indicated.
- C. Galvanize loose steel lintels located in exterior walls.

2.12 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.

2.13 FINISHES, GENERAL

- 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.

2.14 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M 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 railings 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.

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1. Shop prime with primer specified in Section 099000 "Painting and Coating." 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. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- 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.

### 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.

#### 3.2 INSTALLING 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.

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- B. Anchor supports for ceiling hung toilet partitions securely to, and rigidly brace from, building structure.
- C. 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.
- D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
  - 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

### 3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099000 "Painting and Coating."
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION

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SECTION 055113 - METAL PAN STAIRS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Preassembled steel stairs with concrete-filled treads.

1.2 COORDINATION

- A. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and installation instructions. Furnish items to be embedded in concrete or masonry.

1.3 ACTION SUBMITTALS

- A. Product Data: For metal stairs and the following:
  - 1. Stair treads and platforms.
  - 2. Paint products.
- B. Delegated-Design Submittal: Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. 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."

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs.
- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Uniform Load: 100 lbf/sq. ft.
  - 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
  - 3. Uniform and concentrated loads need not be assumed to act concurrently.
  - 4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
  - 5. Limit deflection of treads, platforms, and framing members to  $L/360$  or 1/4 inch, whichever is less.
- C. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. Component Importance Factor: 1.5.

### 2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components 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 A 36/A 36M.
- C. Steel Tubing: ASTM A 500 (cold formed).

### 2.3 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
- D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit

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masonry and four 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, Class Fe/Zn 5, unless otherwise indicated.

## 2.4 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- B. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
- C. Welded Wire Reinforcement: ASTM A 185/A 185M, 6 by 6 inches, W1.4 by W1.4, unless otherwise indicated.

## 2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
  1. Join components by welding unless otherwise indicated.
  2. Use connections that maintain structural value of joined pieces.
- B. Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. 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.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections 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. Weld exposed corners and seams continuously unless otherwise indicated.
  5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards."
    - a. Commercial Stairs: Type 3 welds; partially dressed weld with spatter removed.

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- G. Commercial Stairs: Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

## 2.6 STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," and specified Class.
- B. Stair Framing:
  - 1. Fabricate stringers of steel channels.
    - a. Provide closures for exposed ends of channel stringers.
  - 2. Construct platforms of steel plate or channel headers and miscellaneous framing members as needed to comply with performance requirements.
  - 3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers.
    - a. Commercial Stairs: Fabricate and join so bolts are not exposed on finished surfaces.
  - 4. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet; minimum 0.067 inch thick.
  - 1. Directly weld metal pans to stringers; locate welds on top of subtreads where they are concealed by concrete fill. Do not weld risers to stringers.
  - 2. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
  - 3. Shape metal pans to include nosing integral with riser.
  - 4. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.
    - a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

## 2.7 FINISHES

- A. Finish metal stairs after assembly.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
  - 1. Interior Stairs: SSPC-SP 3, "Power Tool Cleaning."
- C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLING METAL STAIRS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. 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.
- F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.
- G. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."

3.2 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 same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

END OF SECTION



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SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Steel pipe and tube railings.

1.2 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.

1.3 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.
- D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.

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- B. Welding certificates.
- C. 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.
- D. Evaluation Reports: For post-installed anchors , from ICC-ES.

#### 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

#### 1.7 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 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.
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. applied in any direction.
    - b. Concentrated load of 200 lbf 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 applied horizontally on an area of 1 sq. ft..
    - b. Infill load and other loads need not be assumed to act concurrently.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F material surfaces.

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## 2.2 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 and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

## 2.3 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- 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.

## 2.4 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. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
- 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.
  - 2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
  - 3. Provide tamper-resistant flat-head machine screws for exposed fasteners 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.

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1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

## 2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- 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 099000 "Painting and Coating."
- E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- F. Intermediate Coats and Topcoats: Provide products that comply with Section 099000 "Painting and Coating."
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- H. 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.

## 2.6 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 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 either welded or nonwelded 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. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
  - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- K. Form Changes in Direction as Follows:
  - 1. By bending or by inserting prefabricated elbow fittings.
- L. 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.
- M. Close exposed ends of railing members with prefabricated end fittings.
- N. 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 or less.
- O. 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.
- P. 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.

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- Q. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

## 2.7 STEEL AND IRON FINISHES

- A. Galvanized Railings:
1. Hot-dip galvanize indicated 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. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, galvanize anchors to be embedded in exterior concrete or masonry.
- E. 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. Other Railings: SSPC-SP 3, "Power Tool Cleaning."
- F. 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.
- G. Shop-Painted Finish: Comply with Section 099000 "Painting and Coating."
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.

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### 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.
  - 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.
- 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. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. 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.
- C. 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. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with 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.

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- 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:
  - 1. For aluminum pipe railings, attach posts using fittings designed and engineered for this purpose.
  - 2. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

### 3.5 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends or connected to railing ends using nonwelded connections.
- B. 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.
- C. 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 wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
  - 4. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.

### 3.6 ADJUSTING AND CLEANING

- A. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099000 "Painting and Coating."
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

### 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



SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Rooftop equipment wood bases and support curbs.
  - 2. Rooftop wood blocking and nailers.
  - 3. Interior concealed wood blocking and nailers.
  - 4. Plywood backing panels.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
  - 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.

1.3 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.

1.4 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.    Provide dressed lumber, S4S.
- B.    Maximum Moisture Content of Lumber: 19 percent.

2.2      WOOD-PRESERVATIVE-TREATED MATERIALS

- A.    Preservative Treatment by Pressure Process: AWP A 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.
- 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 items indicated on Drawings, and the following:
  - 1.    Wood nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
  - 2.    Wood plates, sills, blocking, and similar concealed members in direct contact with masonry or concrete.

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 and smoke developed rating of 450 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 beyond the centerline of the burners at any time during the test.
  - 1.    Use treatment that does not promote corrosion of metal fasteners.
  - 2.    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.

- C. Kiln-dry after treatment.
  - 1. Lumber: 19 percent maximum moisture content.
  - 2. Plywood: 15 percent maximum moisture content.
- D. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
- E. Application: Treat items indicated on Drawings, and the following:
  - 1. Concealed blocking.
  - 2. Roof blocking.
  - 3. Wood nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
  - 4. 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.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber and any of the following species:
  - 1. Hem-fir (north); NLGA.
  - 2. Mixed southern pine; SPIB.
  - 3. Spruce-pine-fir; NLGA.
  - 4. Hem-fir; WCLIB or WWPA.
  - 5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
- C. Select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

## 2.5 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, Exterior, AC, fire-retardant treated, 3/4-inch thick.

## 2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. All Applications: ASTM A 153/A 153M hot-dip galvanized.
- 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:
  - 1. Cold-Formed Metal Framing: ASTM C 954.
  - 2. Other Metal Framing: ASTM C 1002.
- F. Lag Bolts: ASME B18.2.1.
- G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 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: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
  - 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

## 2.7 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or 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.

## 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 carpentry supports to comply with requirements for attaching other construction.
- B. Where lumber without preservative treatment is attached to concrete or masonry, install continuous flexible flashing separator between wood and substrate.
- C. Install plywood backing panels by fastening to studs with fire retardant classification marking exposed to view; coordinate locations with utilities requiring backing panels.
- D. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- E. 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.

- F. 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.
- G. 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 BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for 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.

END OF SECTION

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SECTION 061516 - WOOD ROOF 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 glued-laminated wood roof decking.
- B. Related Requirements:
  - 1. Section 061000 "Rough Carpentry" for dimension lumber items associated with wood roof decking.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. For glued-laminated wood roof decking, include installation instructions and data on lumber, adhesives, and fabrication.
- B. Samples: 24 inches (600 mm) long, showing the range of variation to be expected in appearance of wood roof decking.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Schedule delivery of wood roof decking to avoid extended on-site storage and to avoid delaying the Work.

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- B. Store materials under cover and protected from weather and contact with damp or wet surfaces. Provide for air circulation within and around stacks and under temporary coverings. Stack wood roof decking with surfaces that are to be exposed in the final Work protected from exposure to sunlight.

## PART 2 - PRODUCTS

### 2.1 WOOD ROOF DECKING, GENERAL

- A. General: Comply with DOC PS 20 and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

### 2.2 GLUED-LAMINATED WOOD ROOF DECKING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Disdero Lumber Company.
  - 2. Boise Cascade
  - 3. Structural Wood Systems; A Division of Harrison Industries.
- B. Face Species: Douglas Fir
- C. Roof Decking Nominal Size: 2x8 or 3x8 as indicated on drawings.
- D. Face Grade: Custom or Supreme: Clear face is required. Occasional pieces may contain a small knot or minor characteristic that does not detract from the overall appearance.
- E. Moisture Content: Provide wood roof decking with 15 percent maximum moisture content at time of dressing.
- F. Face Surface: Smooth.
- G. Edge Pattern: Vee grooved.
- H. Laminating Adhesive: Wet-use type complying with ASTM D 2559.
  - 1. Adhesives shall contain no urea-formaldehyde resins.

### 2.3 ACCESSORY MATERIALS

- A. Fasteners for Glued-Laminated Roof Decking: Provide fastener size and type complying with requirements in "Installation" Article for installing laminated roof decking.
- B. Nails: Common; complying with ASTM F 1667, Type I, Style 10.

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- C. Spikes: Round; complying with ASTM F 1667, Type III, Style 3.
- D. Fastener Material: Hot-dip galvanized steel.
- E. Penetrating Sealer: Clear sanding sealer complying with Section 099300 "Staining and Transparent Finishing" and compatible with topcoats specified for use over it.
  - 1. Sealers shall have a VOC content of 350 g/L or less.

## 2.4 FABRICATION

- A. Predrill roof decking for lateral spiking to adjacent units to comply with AITC 112.
- B. Seal Coat: After fabricating and surfacing roof decking, apply a saturation coat of penetrating sealer in fabrication shop.
- C. Apply indicated finish materials to comply with Section 099300 "Staining and Transparent Finishing" in fabrication shop.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine support framing in areas to receive wood roof decking for compliance with installation tolerances and other conditions affecting performance of wood roof decking.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install laminated wood roof decking to comply with manufacturer's written instructions.
  - 1. Locate end joints for single span lay-up.
  - 2. Nail each course of glued-laminated wood roof decking at each support with one nail slant nailed above the tongue and one nail straight nailed through the face.
    - a. Use 30d nails for 3x8 roof decking.
    - b. Use 12d nails for 2x8 roof decking
  - 3. Slant nail each course of glued-laminated wood roof decking to the tongue of the adjacent course at 30 inches o. c. and within 12 inches of the end of each unit. Stagger nailing 15 inches in adjacent courses.
    - a. Use 8d nails for 3x8 roof decking.



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- b. Use 6d nails for 2x8 roof decking.

### 3.3 ADJUSTING

- A. Repair damaged surfaces and finishes after completing erection. Replace damaged roof decking if repairs are not approved by Architect.

### 3.4 PROTECTION

- A. Provide water-resistive barrier over roof decking as the Work progresses to protect roof decking until roofing is applied.

END OF SECTION 061516

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SECTION 061600 - SHEATHING  
PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Wall sheathing.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.

1.3 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 WALL SHEATHING

- A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. CertainTeed Corporation; GlasRoc.
  - b. G-P Gypsum Corporation; Dens-Glass Gold.
  - c. National Gypsum Company; Gold Bond eXP.
  - d. United States Gypsum Co.; Securock.
2. Type and Thickness: Type X, 5/8 inch thick.
3. Size: 48 by 96 inches for vertical installation.

2.2 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. For wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M of Type 304 stainless steel.

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- B. 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, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
  - 1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C 1002.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- B. Coordinate wall 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.
- C. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- D. 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 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 boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
  - 3. Install boards with a 1/4-inch 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. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
  - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

END OF SECTION

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
  - 1. Interior standing and running trim.
  - 2. Interior frames around all atrium doors and windows.
  - 3. Custom display cases.
  - 4. Shop finishing of interior woodwork.
  - 5. Custom waterfall edge seating cushion.

1.2 ACTION SUBMITTALS

- A. Product Data: For high-pressure decorative laminate, adhesive for bonding plastic laminate, cabinet hardware and accessories and finishing materials and processes.
  - 1. ,
- B. 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 furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
  - 3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, and other items installed in architectural woodwork.
- C. Samples for Verification:
  - 1. Lumber with or for transparent finish, not less than 50 sq. in., for each species and cut, finished on 1 side and 1 edge.
  - 2. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish.
  - 3. Exposed cabinet hardware and accessories, one unit for each type and finish.
  - 4. Melamine (MCP) finish for interior cabinet finish.
  - 5. KV strips and clips.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Certificates: For each type of product, signed by product manufacturer.
- C. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

#### 1.4 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. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
  - 1. Provide AWI Quality Certification Program labels indicating that woodwork, including installation, complies with requirements of grades specified.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Provide mockup of waterfall edge seating as directed by Architect, include fasteners and inserts.
  - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork 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.
- B. Field Measurements: Where woodwork 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 woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

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## 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 interior architectural woodwork can be supported and installed as indicated.
- B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Species and Cut for Transparent Finish: As selected by Architect.
- C. Wood Products: Comply with the following:
  - 1. Softwood Plywood: DOC PS 1.
- D. Softwood Plywood: DOC PS 1.
- E. MCP finish inside cabinet faces
  - 1. Color: Dark Charcoal Grey to match PL-3.
- F. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
  - 1. Basis of Design: Subject to compliance with requirements, provide high-pressure decorative laminates as indicated in Finish Schedule on Drawings or comparable product by one of the following:
    - a. Wilsonart International; Div. of Premark International, Inc.
    - b. Abet Laminati, Inc.
    - c. Arborite; Division of ITW Canada, Inc.
    - d. Formica Corporation.
    - e. Lamin-Art, Inc.
    - f. Nevamar Company, LLC; Decorative Products Div.
    - g. Panolam Industries International Incorporated.
- G. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

## 2.2 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware."
- B. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112.
  - 1. Basis of Design: Knappe and Vogt; 255 Series Steel Standards and Pilaster Shelf Supports.
  - 2. Finish: Provide the following finish at each casework finish type:
    - a. PL-1:
      - 1) Steel Standards Color: Almond.
      - 2) Shelf Supports Color: Almond.
- C. MCP finish:
  - 1. Color: As Selected by Architect from manufacturer's full range of colors.
- D. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
  - 1. Satin Stainless Steel: BHMA 630.
- E. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

## 2.3 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- C. Adhesives, General: Adhesives shall not contain urea formaldehyde.
- D. Adhesive for Bonding Plastic Laminate.

## 2.4 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

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- C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- D. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
  - 1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 Inch Thick or Less: 1/16 inch.
  - 2. Edges of Rails and Similar Members More Than 3/4 Inch Thick: 1/8 inch.
  - 3. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch.
- E. 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 indicated on Shop Drawings before disassembling for shipment.
- F. Shop-cut openings to maximum extent possible to receive hardware, 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 openings in countertops with a coat of varnish.
- G. Install glass to comply with applicable requirements in Division 08 Section "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

2.5 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH, WD-4

- A. Grade: Custom.
- B. Wood Species and Cut: To match existing in Health Room 126.
- C. For trim items wider than available lumber, use veneered construction. Do not glue for width.
- D. For rails wider or thicker than available lumber, use veneered construction. Do not glue for width or thickness.
- E. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
- F. Assemble casings in plant except where limitations of access to place of installation require field assembly.



2.6 INTERIOR FRAMES TRANSPARENT FINISH, WD-1

- A. Grade: Custom.
- B. Wood Species and Cut: Maple, to match Architect's sample.
- 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.

2.7 CUSTOM DISPLAY CASES

- A. Recessed Display Case: Fabricate display case; with finished interior, operable glazed doors at front, and trim on face to cover edge of recessed opening.
  - 1. Display Case Cabinet: Hardwood veneer plywood.
    - a. Veneer Species: Manufacturer's standard species with natural lacquered finish unless otherwise indicated.
  - 2. Face Frame: Wood, species to match interior of cabinet box with natural lacquered finish unless otherwise indicated.
- B. Glazed Sliding Doors: Tempered glass; unframed; with extruded-aluminum top and bottom track; supported on nylon or ball-bearing rollers; with plastic top guide and rubber bumpers. Equip each door with ground finger pull and adjustable cylinder lock with two keys.
  - 1. Thickness: Not less than 5 mm thick unless otherwise indicated.
  - 2. Number of Doors: Two unless otherwise indicated.
  - 3. Hardware: Provide products as manufactured by Richelieu Hardware.
- C. Shelves: 6-mm-thick tempered glass; supported on adjustable shelf standards and supports.
  - 1. Shelf Depth: 6 inches unless otherwise indicated.
  - 2. Number of Shelves: Three unless otherwise.
- D. Sill: Solid surface, SS-1.
  - 1. Finish and Color: As selected by Architect.
- E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112; recess mounted in rear surface. Provide standards extending full height of display case.
- F. Back Panel: Natural-cork tackboard panel.
- G. Size: As indicated on Drawings.
- H. Materials:
  - 1. Extruded-Aluminum Bars and Shapes: ASTM B 221, Alloy 6063.

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2. Aluminum Tubing: ASTM B 429/B 429M, Alloy 6063.
3. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.

## 2.8 CUSTOM WATERFALL EDGE SEATING MATERIALS

- A. Description: One piece seat cushion wrapped with Fiber and encased in muslin, attached to a terrazzo base with Velcro, anchored to substrate.
- B. Fabric: As specified in Finish Schedule. F-2
- C. Velcro.
- D. Upholstery Components:
  1. Padding:
    - a. High-density polyurethane foam.
  2. Other upholstery components as indicated on Drawings.
- E. Plywood.
- F. Mounting: As indicated on Drawings.

## 2.9 SHOP FINISHING

- A. Grade: Provide finishes of same grades as items to be finished.
- B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
- C. Shop Priming: Shop apply the prime coat including backpriming, if any, for transparent-finished items specified to be field finished. Refer to Division 09 painting Sections 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. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.
- E. Transparent Finish:
  1. Grade: Premium Custom.
  2. AWI Finish System: Catalyzed lacquer.
  3. Staining: To match existing for flush wood panel.

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4. Wash Coat for Stained Finish: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
6. Sheen: To match existing for flush wood panel.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

#### 3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 36 inches long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.
  1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.
  2. Install wall railings on indicated metal brackets securely fastened to wall framing.
  3. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.

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- G. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
  - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
  - 2. Maintain veneer sequence matching of cabinets with transparent finish.
  - 3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips.
- H. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

### 3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

## SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.
3. Cabinet Hardware

##### B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.
2. Section 123661.16 "Solid Surfacing Countertops."

#### 1.2 COORDINATION

- ##### A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

- ##### B. Hardware Coordination: Distribute copies of approved hardware schedule specified.

#### 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 for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

##### B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details for every installation location.
2. Show large-scale details.

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3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
  4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.
- C. Samples: For each exposed product and for each color and texture specified, in manufacturer's or manufacturer's standard size.
- D. Samples for Initial Selection: For each type of exposed finish.
- E. Samples for Verification: For the following:
1. Plastic Laminates: 12 by 12 inches, for each type, color, pattern, and surface finish required.
    - a. Provide one sample applied to core material with specified edge material applied to one edge.
  2. Thermoset Decorative Panels: 12 by 12 inches, for each color, pattern, and surface finish.
    - a. Provide edge banding on one edge.
  3. Corner Pieces:
    - a. Cabinet-front frame joints between stiles and rails and at exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
    - b. Miter joints for standing trim.
  4. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Product Certificates: For each type of product.
- C. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.
- D. Field quality-control reports.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: 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.

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- B. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
  - 1. Provide AWI Quality Certification Program labels indicating that woodwork, including installation, complies with requirements of grades specified.
- 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 mockups of typical architectural cabinets as shown on Drawings, finished.
    - a. One full size, finished set of cubbies complete with hardware and upper cabinet.
    - b. One full size, finished closet, complete with hardware and removable panel
  - 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. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or 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 cabinets 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. Field Measurements: Where cabinets 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 cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

### PART 2 - PRODUCTS

#### 2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.

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1. Provide labels from AWI certification program indicating that woodwork, including installation, complies with requirements of grades specified.
- B. Architectural Woodwork Standards Grade: Custom.
- C. Type of Construction: Frameless.
- D. Door and Drawer-Front Style: Flush overlay.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
- F. Laminate Cladding for Exposed Surfaces:
  1. Horizontal Surfaces: Grade HGS.
  2. Vertical Surfaces: Grade HGS
  3. Edges: Grade HGS
- G. Materials for Semiexposed Surfaces:
  1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS
    - a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch-~~(0.460-mm)~~ minimum thickness, matching laminate in color, pattern, and finish
    - b. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
    - c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS
  2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding
  3. Drawer Bottoms: Thermoset decorative panels
- H. Dust Panels: 1/4-inch-plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
  1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.
- K. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
  1. Refer to Architectural Drawings and finish schedule.



## 2.2 GENERAL CABINET CONSTRUCTION REQUIREMENTS

- A. Lamination System: Doors, finished end panels, and other decorative exterior laminate surfaces shall be composed of minimum 3/4" core, laminated exterior, with .030 inch high pressure plastic laminate, and interior with .020" high pressure cabinet liner, which includes all open shelf storage units. Lamination with hybrid P.V.A. Type III water resistant adhesives. Total thickness 13/16".
- B. Structural Cabinet Body: Cabinet backs shall be minimum 3/8" thick, inset from rear of body, Fully housed sides, and back shimmed. Provide 3/4" thick stiffeners glued and fastened to back/body as specified herein. Back perimeter and stiffeners to be fully sealed with hot melt adhesive.
- C. Interior Space: All cabinets to have clear span interiors. No vertical dividers allowed, unless specifically noted on the drawings.
- D. Heavy Components: Wall cabinet tops and bottoms, and all bookstack shelves shall be minimum 1" thick, for additional load support. Shelves in door cabinets 30" or wider shall be 1" thick. Shelves in open cabinets, regardless of width, shall be 1" thick.
- E. Structural Drawer Body: Drawer body material shall be multi-directional fiberboard with bottom recessed, captured on all four sides, and sealed with hot melt adhesive. Provide under body stiffener as specified herein. Particleboard bodies and/or surface applied bottoms are not acceptable.
- F. Drawer Suspension: Drawer slides shall be self-closing design, epoxy powder coated, with positive instop, outstop, and keeper. Dynamic (operational) load rating to be minimum 100 lbs. Static load rating to be minimum 150 lbs.
- G. Structural Cabinet Support: Cabinet sub base shall be of a separate and continuous ladder-type platform design, leveled and floor mounted prior to cabinet body placement. Material to be exterior grade plywood. No cabinet sides-to-floor will be allowed.

## 2.3 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
  - 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
  - 1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
  - 2. Particleboard: ANSI A208.1, Grade M-2.
  - 3. Straw-Based Particleboard: ANSI A208.1, Grade M-2, except for density.
  - 4. Softwood Plywood: DOC PS 1, medium-density overlay.

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5. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.
6. Provide minimum core thicknesses, prior to lamination, as follows:
  - a. 3/8" - cabinet backs, unless noted otherwise.
  - b. 1/2" - dividers (where detailed).
  - c. 3/4" - base and tall cabinet tops and bottoms, cabinet sides, drawer spreaders, doors, drawer head, cabinet back rear hangstrips, dividers (where detailed) and exposed cabinet backs.
  - d. 1" - wall cabinet tops and bottoms, door-cabinet shelving thirty (30") inches wide and over, exposed cabinet shelving and off-wall shelving of all widths.
7. Fiberboard components to be of the following minimum core thicknesses, prior to lamination:
  - a. 3/8" - drawer bottom.
  - b. 1/2" - drawer sides, subfront, and back, and drawer under bottom stiffeners.
  - c. 3/4" - framed glass doors.

## 2.4 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.
  1. Hinges:
    - a. Heavy duty, five knuckle 2-3/4 inch institutional type hinge shall meet ANSI/BHMA A156.9 Grade 1 requirements. Mill ground, hospital tip, tight pin feature will all edges eased. Hinge to be full wrap around type of tempered steel .095 inch thick. Each hinge to have minimum nine (9) screws, #7, 5/8 inch FHMS to assure positive door attachment.
    - b. One pair per door forty-eight (48") inches in height. One and one-half pair per door over forty-eight (48") inches in height. Hinge to accommodate 13/16" thick laminated door.
    - c. Finish to be brushed chrome.
- B. Drawer and Pulls: As indicated on Drawings or approved equal below:
  1. Richelieu Contemporary Metal Pull 5632, 4" Centers, Brushed Nickel Finish.
  2. Richelieu, Functional Metal Pull 1076, 4" Centers, Chrome Finish.
  3. Liberty Hardware 4" Centers Die Cast Aluminum Pulls. Length 4-3/8", Width 4-3/8", Projection 7/8".
  4. Drawer Slides:
    - a. Standard Drawers: self-closing design, with white epoxy powder coat finish. Positive in-stop, out-stop, and out-keeper to maintain drawer in eighty (80%) percent open position. Captive nylon rollers, front and rear. Minimum one-hundred (100) lb. dynamic load rating at 50,000 cycles. Minimum one-hundred fifty (150) lb static load rating.
  5. Catches: Shall provide opening resistance in compliance with the Americans with Disabilities Act. Provide one top-mounted catch for base, wall and tall cabinet doors. Inactive door on tall cases shall have one catch and one surface bolt. Catch housing to molded in white.

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6. Adjustable Shelf Supports: Shall be twin pin design, with anti tip-up shelf restraints for both 3/4" and one (1") inch shelves. Design to include keel to retard shelf slide-off, and slot for ability to mechanically attach shelf to clip. Load rating to be minimum three-hundred (300) lbs at each support without failure (reference Item 1.3.A above). Cabinet interior sides shall be flush, without shelf system permanent projection.
7. Locks: To be disc tumbler type, keyed alike in each room, keyed differently from room to room, and master keyed all alike. Finish to be dull chrome.
  - a. Hinged doors and drawers to be National Lock #M4-7054.
  - b. Provide for locks where shown on the drawings.
- C. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
- D. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

## 2.5 CABINET CONSTRUCTION

- A. Cabinet Sub Base: Unless more stringent requirements are shown or noted elsewhere, to be separate and continuous (no cabinet body sides-to-floor), water resistant exterior grade plywood, with concealed fastening to cabinet bottom. Ladder-type construction of front, back and intermediates to form a secure and level platform to which cabinets attach.
- B. Cabinet Top and Bottom:
  1. Solid sub-top to be furnished for all base and tall cabinets.
  2. Wall cabinet and library stack bottoms and tops to be one (1") inch thick.
  3. Exterior exposed wall cabinet bottoms to be pressure fused laminate on both sides. Assembly devices to be concealed on bottom side of wall cabinets.
- C. Cabinet Ends: Cabinet ends shall have holes drilled for adjustable shelves at 1-1/4" O.C. Exposed exterior cabinet ends to be laminated with high pressure plastic laminate, balanced with high pressure cabinet liner interior surface. All finished ends to extend to the wall, the full depth of the countertops, whether cabinets are same depth as countertops or shorter.
- D. Coordinate raceway locations with Electrical Contractor and shop cut finished ends to accommodate raceways.
- E. Fixed and Adjustable Shelves: shall be 3/4" thick behind doors and less than thirty (30") inches wide. Shelves to be one (1") inch thick for widths thirty (30") inches and wider, and for all open cabinet shelves (no doors).
- F. Cabinet Backs:
  1. Cabinet backs to be fully housed into sides, top, and bottom, recessed 7/8" from cabinet rear. Rear, unexposed side of back panel to receive continuous bead of hot melt adhesive at joint between back and sides/top/bottom.
  2. Hang rails shall be glued to rear of cabinet back and mechanically fastened to cabinet sides. Provide minimum of two (2) fasteners at base, two (2) at wall, and three (3) at tall cabinets (typ.).

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3. Exposed exterior backs to be high pressure plastic laminate balanced with high pressure cabinet liner.

G. Door and Drawer Fronts:

1. Laminated door and drawer fronts to be 13/16" thick for all hinged and sliding doors. Drawer fronts and hinged doors are to overlay the cabinet body. Maintain a maximum 1/8" reveal between pairs of doors, between door and drawer front, or between multiple drawer fronts within the cabinet.
2. Stile and rail doors to be 13/16" thick with minimum full 1/4" tempered glass. All exposed lite opening edges to be trimmed and glazed with extruded vinyl glazing bead.

H. Drawers:

1. Drawer fronts shall be applied to separate drawer body component sub front.
2. Drawer sides shall be dadoed and glued to receive front and back, machine squared and held under pressure while hot melt glued and pinned together.
3. Drawer bottom to be housed into front, sides, and back. Underside of drawer to receive continuous bead of hot melt adhesive at joint between bottom and back/sides/front, for sealing and rigidity. Reinforce drawer bottoms with 1/2" by four (4") inch, front-to-back intermediate underbody stiffeners, hot melt glued and mechanically fastened. One (1) at twenty-four (24") inches, two (2) at thirty (36") inches, and four (4) at forty-eight (48") inches.
4. All drawers shall be fitted with roller guides, as specified in Item 2.2.E.3 above.

I. Vertical and Horizontal Dividers: provide one of the following, as indicated by unit model number.

1. Natural hardboard, 1/4" thick, smooth on both faces. Secure in cabinet body with molded plastic clips.
2. Pressure fused laminate, 3/4" thick. Secure to cabinet body with molded plastic clips or dowels.

J. Door/Drawer Front Rail: shall be minimum 3/4" by six (6") inches by full width of cabinet body, with rails immediately behind all door/drawer, and multiple drawer horizontal joints to maintain exact body dimensions, close off reveal, and be locator for lock strikes.

## 2.6 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.
- B. 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.
- C. Adhesives: Do not use adhesives that contain urea formaldehyde.
- D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement
  1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

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## 2.7 FABRICATION

- A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.
- B. Complete fabrication, including assembly 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 architectural cabinet fabrication will be complete.
  - 2. Trial fit assemblies at manufacturer's 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.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, 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.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

### 3.2 INSTALLATION

- A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
  - 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

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2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch-penetration into wood framing, blocking, or hanging strips.

### 3.3 FIELD QUALITY CONTROL

- A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.

1. Inspection entity shall prepare and submit report of inspection.

### 3.4 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION

SECTION 070150.19 - PREPARATION FOR REROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. The Work of This Section Includes:
  - 1. Temporary roofing.
  - 2. Roof re-cover preparation.
  - 3. Base flashing removal.
  - 4. Fastener pull-out testing.
  - 5. Disposal.

1.2 DEFINITIONS

- A. EPS: Molded (expanded) polystyrene.
- B. Full Roof Tear-off: Removal of existing roofing system down to existing roof deck.
- C. Partial Roof Tear-off: Removal of selected components and accessories from existing roofing system.
- D. Roofing Terminology: Definitions in ASTM D1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.
- E. Roof Re-Cover Preparation: Existing roofing system is to remain and be prepared for new roof installed over it.

1.3 PREINSTALLATION MEETINGS

- A. Preliminary Roofing Conference: Before starting removal Work, conduct conference at Project site.
  - 1. Meet with Owner, Architect, roofing installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
  - 2. Review methods and procedures related to reroofing, 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.

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- d. Construction schedule and availability of materials, Installer's personnel, equipment, and facilities needed to avoid delays.
- e. Existing roof deck 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. Governing regulations and requirements for insurance and certificates if applicable.
- k. Existing conditions that may require Architect notification before proceeding.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- 1. Include certificate that Installer is approved by warrantor of existing roofing system.
  - 2. Include certificate that Installer is licensed to perform asbestos abatement.

- B. Field Test Reports: Fastener pull-out test report.

- C. Photographs or Video: Show existing conditions of adjoining construction and site improvements, including exterior and interior finish surfaces, that might be misconstrued as having been damaged by reroofing operations.

- 1. Submit before Work begins.

#### 1.6 FIELD CONDITIONS

- A. Existing Roofing System: SBS-modified bituminous roofing.
- B. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.
- C. 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.



## PART 2 - PRODUCTS

### 2.1 TEMPORARY ROOFING MATERIALS

- A. Design and selection of materials for temporary roofing are Contractor's responsibilities.

### 2.2 INFILL AND REPLACEMENT MATERIALS

- A. Use infill materials matching existing roofing system materials unless otherwise indicated.
  - 1. Infill materials are specified in Section 075323 Ethylene-Propylene-Diene-Monomer (EPDM) Roofing unless otherwise indicated.
- B. Steel deck is specified in Section 053100 "Steel Decking."
- C. Wood blocking, curbs, and nailers are specified in Section 061000 "Rough Carpentry."
- D. Plywood roof sheathing is specified in Section 061600 "Sheathing."
- E. Parapet Sheathing:
  - 1. ASTM C1177/C1177M or ASTM C1278/C1278M water-resistant gypsum substrate; 5/8 inch (16 mm) thick.
- F. Fasteners: Factory-coated steel fasteners with metal or plastic plates listed in FM Approvals' RoofNav, and acceptable to new roofing system manufacturer.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protection of In-Place Conditions:
  - 1. Limit traffic and material storage to areas of existing roofing that have been protected.
  - 2. Maintain temporary protection and leave in place until roofing has been completed. Remove temporary protection on completion of roofing.
- 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 to verify that they are not blocked or restricted.
  - 1. Immediately notify Architect of any blockages or restrictions.

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- E. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday.
  - 1. Prevent debris from entering or blocking roof drains and conductors.
    - a. Use roof-drain plugs specifically designed for this purpose.
    - b. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.
  - 2. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new roofing system, provide alternative drainage method to remove water and eliminate ponding.
    - a. Do not permit water to enter into or under existing roofing system components that are to remain.

### 3.2 ROOF TEAR-OFF – **ALTERNATE ONLY**

- A. Lower removed roofing materials to ground using dust-tight chutes or other acceptable means of removing materials from roof areas.
- B. Full Roof Tear-off: Where indicated on Drawings as part of **Alternate bid scope**, remove existing roofing and other roofing system components down to the existing roof deck.
  - 1. Remove **substrate board, vapor retarder, roof insulation and cover board**.
  - 2. Remove base flashings and counter flashings.
  - 3. Remove perimeter edge flashing and gravel stops.
  - 4. Remove copings.
  - 5. Remove expansion-joint covers.
  - 6. Remove flashings at pipes, curbs, mechanical equipment, and other penetrations.
  - 7. Remove roof drains indicated on Drawings to be removed.
  - 8. Remove wood blocking, curbs, and nailers.
  - 9. Bitumen and felts that are firmly bonded to concrete decks are permitted to remain if felts are dry.
    - a. Remove unadhered bitumen, unadhered felts, and wet felts.
  - 10. Remove excess asphalt from steel deck.
    - a. A maximum of 15 lb/100 sq. ft. (0.72 kg/sq. m) of asphalt is permitted to remain on steel decks.
  - 11. Remove fasteners from deck.

### 3.3 DECK PREPARATION

- A. Inspect deck after tear-off of roofing system.

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- B. 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.
  - 1. Do not proceed with installation until directed by Architect.
- C. If deck surface is unsuitable 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.
- D. Replace steel deck as directed by Architect.

### 3.4 INFILL MATERIALS INSTALLATION

- A. Immediately after roof tear-off, and inspection and repair, if needed, of deck, fill in tear-off areas to match existing roofing system construction.
  - 1. Installation of infill materials is specified in Section 075323 "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing."
  - 2. Installation of wood blocking, curbs, and nailers is specified in Section 061000 "Rough Carpentry."
- B. Install new roofing patch over roof infill area.
  - 1. If new roofing is installed the same day tear-off is made, roofing patch is not required.

### 3.5 ROOF RE-COVER PREPARATION

- A. Remove blisters, ridges, buckles, and other substrate irregularities from existing roofing that inhibit new roofing from conforming to substrate.
  - 1. Verify that existing substrate is dry before proceeding with installation.
  - 2. Survey existing roofing that is to remain using infrared color thermography according to ASTM C1153.
    - a. Prepare survey report of initial scan indicating locations of entrapped moisture, if any, and area calculations of locations of entrapped moisture.
  - 3. Remove materials that are wet and damp.
  - 4. Power vacuum the existing roof surface.
    - a. If recommended by foam manufacturer, prime dried surface at recommended rate with recommended primer.
- B. Partial Roof Tear-off: Where required based on moisture test results remove existing roofing down to roof deck and immediately check for presence of moisture.
  - 1. Engage a qualified testing agency to perform the following test:

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2. Survey exposed substrate that is to remain using infrared color thermography according to ASTM C1153.
  - a. Prepare survey report of initial scan indicating locations of entrapped moisture, if any, and area calculations of locations of entrapped moisture.
3. Inspect wood blocking, curbs, and nailers for deterioration and damage.
  - a. If wood blocking, curbs, or nailers have deteriorated, immediately notify Architect.
4. Remove excess asphalt from steel deck that is exposed by removal of wet or damp materials.
  - a. A maximum of 15 lb/100 sq. ft. (0.72 kg/sq. m) of asphalt is permitted to remain on steel decks.
5. Remove fasteners from deck.

### 3.6 BASE FLASHING REMOVAL

- A. Remove existing base flashings.
  1. Clean substrates of contaminants, such as asphalt, sheet materials, dirt, and debris.

### 3.7 FASTENER PULL-OUT TESTING

- A. Retain independent testing and inspecting agency to conduct fastener pull-out tests according to SPRI FX-1, and submit test report to Architect before installing new roofing system.
  1. Obtain Architect's and roofing manufacturer's approval to proceed with specified fastening pattern.
    - a. Roofing manufacturer may furnish revised fastening pattern commensurate with pull-out test results.

### 3.8 DISPOSAL

- A. Collect demolished materials and place in containers.
  1. Promptly dispose of demolished materials.
  2. Do not allow demolished materials to accumulate on-site.
  3. 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.

END OF SECTION 070150.19

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SECTION 071113 - 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, emulsified-asphalt dampproofing.
- B. Related Requirements:
  - 1. Section 033000 "Cast-in-Place Concrete" for bituminous vapor retarders under slabs-on-grade.
  - 2. Section 042000 "Unit Masonry" for mortar parge coat on masonry surfaces.

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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide auxiliary materials recommended in writing by manufacturer of primary materials.

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## 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, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Trowel Coats: ASTM D1227, Type II, Class 1.
- B. Fibered Brush and Spray Coats: ASTM D1227, Type II, Class 1.
- C. Brush and Spray Coats: ASTM D1227, Type III, Class 1.

## 2.4 AUXILIARY MATERIALS

- A. Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
- B. Emulsified-Asphalt Primer: ASTM D1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.
- C. Patching Compound: latex-modified repair mortar of type recommended in writing by dampproofing manufacturer.

## 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.

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- 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.

### 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 6 inches 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.

### 3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Unparged Masonry Foundation Walls: Apply primer and one fibered brush or spray coat at not less than 3 gal./100 sq. ft. (1.2 L/sq. m)

### 3.5 PROTECTION

- A. Correct dampproofing that does not comply with requirements; repair substrates, and reapply dampproofing.

END OF SECTION

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Foam-plastic board insulation.
  - 2. Mineral-wool blanket insulation.
  - 3. Sound attenuation firesafing batt insulation (SAFB)
  - 4. Vapor retarders.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- B. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.4 QUALITY ASSURANCE

- A. 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.

1.5 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 before installation time.
  - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.



## PART 2 - PRODUCTS

### 2.1 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. DiversiFoam Products.
    - b. Kingspan; GreenGuard Insulation Board.
    - c. DuPont Styrofoam
    - d. Owens Corning.
  - 2. Type IV, 25 psi.
  - 3. Minimum Thickness: 3-inches
  - 4. Minimum R-Value at 1 inch: 4.5.
- B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

### 2.2 MINERAL-WOOL BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Owens Corning Thermafiber.
  - 2. Rockwool.
  - 3. Johns Manville.
- B. Unfaced, Mineral-Wool Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

### 2.3 SOUND ATTENUATION FIRESAFING BATT INSULATION

- A. Manufacturers:
  - 1. Owens Corning; Thermafiber SAFB.
  - 2. Johns Manville; Mineral Sound Attenuation Fire Batt.
  - 3. Rockwool.
- B. Batt Insulation: ASTM C665, Type I, unfaced semi rigid mineral fiber batt type, 2.5 pcf density, 3 inches thick, with maximum flame/smoke properties of 15/0 in accordance with ASTM E84.
- C. Batt Size: Friction fit of sizes to fit stud spacings.

## 2.4 VAPOR RETARDERS

- A. Polyethylene Vapor Retarders: ASTM D 4397, 6 mils thick, with maximum permeance rating of 0.13 perm.
- B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.
- D. Single-Component Nonsag Urethane Sealant: ASTM C 920, Type I, Grade NS, Class 25, Use NT related to exposure, and Use O related to vapor-barrier-related substrates.
- E. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.

## 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 indicated with self-locking washer in place.
  - 1. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - 2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation indicated.
- B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- 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 square or in diameter.
- C. Z-girt Mounting System
  - 1. Provide insulating horizontal girt system for mounting as indicated on Drawings.
    - a. Mounting Hardware: Provide manufacturer's standard mounting hardware as recommended by manufacturer.
    - b. Where manufacturer does not provide a standard mounting system, provide mounting system as recommended by manufacturer.
  - 2. Manufacturers and Products: Subject to compliance with requirements, provide SMARTci System Building enclosure system with GreenGirt CMH manufactured by Advanced Architectural Products or approved comparable products.
    - a. Knight Wall Systems.
  - 3. Locations: As indicated on Drawings.
- D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing 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 indicated.
- 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. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.
- E. Install rigid installation 1/8 inch gaps. Do not use tape.

#### 3.3 INSTALLATION OF BELOW-GRADE INSULATION

- A. On vertical 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 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 in from exterior walls.

#### 3.4 INSTALLATION OF CAVITY-WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
  - 1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

### 3.5 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Mineral-Wool 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 clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
  - 4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

### 3.6 INSTALLATION OF INSULATION FOR CONCRETE SUBSTRATES

- A. 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. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
  - 2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
  - 3. 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 below indicated thickness.
  - 4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

### 3.7 INSTALLATION OF CURTAIN-WALL INSULATION

- A. Install board insulation in curtain-wall construction where indicated on Drawings according to curtain-wall manufacturer's written instructions.
  - 1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated between insulation and glass.
  - 2. Install insulation where it contacts perimeter fire-containment system to prevent insulation from bowing under pressure from perimeter fire-containment system.

### 3.8 INSTALLATION OF VAPOR RETARDERS

- A. Place vapor retarders on side of construction indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs.
  - 1. Before installing vapor retarders, apply urethane sealant to flanges of metal framing including runner tracks, metal studs, and framing around door and window openings. Seal overlapping joints in vapor retarders with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Seal butt joints with vapor-retarder tape. Locate all joints over framing members or other solid substrates.
  - 2. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.
- C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

### 3.9 PROTECTION

- A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. 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

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## SECTION 072500 - WEATHER BARRIERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Building wrap.
  - 2. Water-Resistive barrier.
  - 3. Flexible flashing.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For water-resistive barrier and flexible flashing, from ICC-ES.

### PART 2 - PRODUCTS

#### 2.1 WATER-RESISTIVE BARRIER

- A. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Chemical Company (The); Styrofoam Weathermate Plus Brand Housewrap.
    - b. DuPont (E. I. du Pont de Nemours and Company); Tyvek CommercialWrap.
    - c. Kingspan.; GreenGuard Classic Wrap.
    - d. Raven Industries Inc.; Fortress Pro Weather Protective Barrier.
  - 2. Water-Vapor Permeance: Not less than 75 perms per ASTM E 96/E 96M, Desiccant Method (Procedure A).
  - 3. Air Permeance: Not more than 0.004 cfm/sq. ft. at 0.3-inch wg when tested according to ASTM E 2178.
  - 4. Allowable UV Exposure Time: Not less than three months.
- B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

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## 2.2 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber 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.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. DuPont (E. I. du Pont de Nemours and Company); DuPont Flashing Tape.
    - b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Vycor Butyl Self Adhered Flashing.
    - c. Protecto Wrap Company; BT-25 XL.
    - d. Raven Industries Inc.; Fortress Flashshield.
- B. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.
- C. Nails and Staples: ASTM F 1667.

## PART 3 - EXECUTION

### 3.1 WATER-RESISTIVE BARRIER INSTALLATION

- A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.
- B. Cover sheathing with water-resistive barrier as follows:
  - 1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
  - 2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.
- C. Building Wrap: Comply with manufacturer's written instructions.
  - 1. Seal seams, edges, fasteners, and penetrations with tape.
  - 2. Extend into jambs of openings and seal corners with tape.

### 3.2 FLEXIBLE FLASHING INSTALLATION

- A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
  - 1. Prime substrates as recommended by flashing manufacturer.
  - 2. Lap seams and junctures with other materials at least 4 inches except that at flashing flanges of other construction, laps need not exceed flange width.
  - 3. Lap flashing over water-resistive barrier at bottom and sides of openings.

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4. Lap water-resistive barrier over flashing at heads of openings.
5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

END OF SECTION



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SECTION 072600 – VAPOR RETARDERS

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. Polyethylene vapor retarders.
- B. Related Requirements:
  - 1. Section 033000 "Cast-in-Place Concrete" for under-slab vapor retarders.
  - 2. Section 072100 "Thermal Insulation" for vapor retarders integral with insulation products.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 VAPOR RETARDERS

- A. Polyethylene Vapor Retarders: ASTM D4397, 10-mil- (0.25-mm-) thick sheet, with maximum permeance rating of 0.1 perm (5.7 ng/Pa x s x sq. m).
- B. Under slab Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 15 mil thick. Include manufacturer's recommended adhesive, pressure-sensitive tape, and accessories.
  - 1. Provide Stego Wrap 15 mil Vapor Barrier (no substitutions).

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## 2.2 ACCESSORIES

- A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- B. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.
- C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

### 3.2 INSTALLATION OF VAPOR RETARDERS ON FRAMING

- A. Place vapor retarders on side of construction indicated on Drawings.
- B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- C. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.
- D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

### 3.3 INSTALLATION OF VAPOR RETARDERS IN CRAWL SPACES AND UNDER SLABS

- A. Install vapor retarders per specification Cast-In-Place Concrete 033000 section 3.8.

### 3.4 PROTECTION

- A. Protect vapor retarders from damage until concealed by permanent construction.

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END OF SECTION

SECTION 074213.16 - METAL PLATE WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes metal plate wall panels.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

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 type of panel and accessory.
- B. Shop Drawings:
  - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
  - 2. Accessories: Include details of the flashing, trim, and anchorage, at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
  - 1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

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1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- 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 mockup of typical metal panel assembly as shown on Drawings, including corner, supports, attachments, and accessories.
  - 2. Water-Spray Test: Conduct water-spray test of mockup of metal panel assembly, testing for water penetration according to AAMA 501.2.
  - 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.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.8 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including rupturing, cracking, or puncturing.
    - b. Deterioration of metals and other materials beyond normal weathering.
  - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show 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: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 330:
  - 1. Wind Loads: As indicated on Drawings.
  - 2. Other Design Loads: As indicated on Drawings.
  - 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Design, fabricate, and erect a dry joint, pressure equalized rainscreen aluminum wall panel system without use of sealants, gaskets, or butyl tape, tested as installed in compliance with AAMA 508, and as follows:
  - 1. Cyclic Static Air Pressure Differential: Pass cycled pressure loading at 25 psf in 100 three-second cycles in accordance with ASTM E1233/E1233M.
  - 2. Air Infiltration: Pass when tested at 1.57 psf (25 mph) in accordance with ASTM E283.
  - 3. Water Penetration:
    - a. Static: Pass water penetration test under 25.0 psf positive static air pressure difference for at least 15 minutes with 5 gallons per sf per hour of water applied in accordance with ASTM E331.

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- b. Dynamic: Pass water penetration test under 15.0 psf dynamic pressure difference for at least 15 minutes with 5 gallons per sf per hour of water applied in accordance with AAMA 501.1.
- C. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 1.57 lbf/sq. ft..
- D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 6.24 lbf/sq. ft.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing 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 (Range): 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 METAL PLATE WALL PANELS

- A. Metal Plate Wall Panels: Provide factory-formed, metal plate wall panels fabricated from single sheets of metal formed into profile for installation method indicated. Include attachment assembly components, and accessories required for weathertight system.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide BOD: PAC-CLAD reveal panel, 24 ga. Aluminum, two pencil ribs profile or approved comparable product.
- B. Panel Depth: 1 inch.
- C. Panel Size: 12" O.C.
- D. Panel Joints: As indicated on Drawings.
- E. Aluminum Sheet: Tension-leveled, smooth aluminum sheet, ASTM B 209, 0.080 inch thick.
  - 1. Exterior Finish: Two-coat fluoropolymer.
    - a. Color: As selected by Architect from manufacturer's full range.
- F. Attachment Assembly: Rainscreen-principle system.

## 2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard z-girts as required for support and alignment of metal panel system.

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- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer. Provide sealant types that are compatible with panel materials, are nonstaining, and do not damage panel finish.

## 2.4 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  - 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
  - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.



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- a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

## 2.5 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. 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.
- C. Aluminum Panels and Accessories:
  1. 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.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
  1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
  2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
    - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

### 3.3 INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 1. Shim or otherwise plumb substrates receiving metal panels.
  - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
  - 3. Install screw fasteners in predrilled holes.
  - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
  - 5. Install flashing and trim as metal panel work proceeds.
  - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
  - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
  - 1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Attachment Assembly, General: Install attachment assembly required to support metal plate wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
  - 1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
- E. Rainscreen-Principle Installation: Install using manufacturer's standard assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach metal plate wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.
  - 1. Install metal plate wall panels to allow individual panels to be installed and removed without disturbing adjacent panels.
  - 2. Do not apply sealants to joints unless otherwise indicated.

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- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
  - 1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended in writing by metal panel manufacturer.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
  - 1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
  - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

### 3.4 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal plate wall panel units within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing agency to perform field tests and inspections.
- B. Water-Spray Test: After installation, test area of assembly shown on Drawings for water penetration according to AAMA 501.2.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.
- D. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.
- E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- F. Prepare test and inspection reports.

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### 3.6 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. EPDM thermoset single-ply roofing.
  - 2. Membrane flashings.
  - 3. Metal flashings.
  - 4. Roof insulation.
  - 5. Walkway Pads.

1.2 REFERENCES

- A. American Society of Civil Engineers (ASCE) - ASCE 7 - Minimum Design Loads for Buildings and Other Structures, Current Revision.
- B. ASTM International (ASTM):
  - 1. ASTM C 1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
  - 2. ASTM D 4637 - Standard Specification for EPDM Sheet Used In Single-Ply Roof \*\*
- C. International Code Council (ICC):
  - 1. International Building Code (IBC).
- D. National Roofing Contractors Association (NRCA) - Low Slope Roofing and Waterproofing Manual, Current Edition.

1.3 DESIGN CRITERIA

- A. Wind Uplift Performance:
  - 1. Roof system is designed to withstand wind uplift forces as calculated using the current revision of ASCE-7.
  - 2. Roof system is designed to achieve a FM 1-90 wind uplift rating.
  - 3. Roof System is designed to achieve 90-psf of uplift testing.
- B. Fire Resistance Performance:
  - 1. Roof system will achieve a UL Class A rating when tested in accordance with UL-790.
- C. Thermal Performance: Roof system will achieve a minimum R value not less than 30.
- D. Drainage: Provide a roof system with positive drainage where all standing water dissipates within 48 hours after precipitation ends.
- E. Building Codes:
  - 1. Roof system will meet the requirements of all federal, state and local code bodies having jurisdiction.

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#### 1.4 SUBMITTALS

- A. Submit under provisions of Section 01.
- B. Qualification Data: For qualified Installer.
  - 1. Approved Installer Letter: Signed by the roofing manufacturer certifying the installer is approved by manufacturer to install their product.
- C. Manufacturer Certificate: Signed by roofing manufacturer certifying that membrane roofing system complies with requirements specified in "Performance Requirements" Article.
  - 1. Submit evidence of complying with performance requirements.
- D. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- E. Detail Drawings:
  - 1. Submit approved plan, section, elevation or isometric drawings which detail the appropriate methods for all flashing conditions found on the project.
  - 2. Coordinate approved drawings with locations found on the Contract Drawings.
- F. Selection Samples: For each finish product specified, two complete sets of chips representing manufacturer's full range of available colors, membranes, and thicknesses.
- G. Closeout Submittals
  - 1. Maintenance Data: For membrane roofing system to include in maintenance manuals.
  - 2. Warranties: Sample of special warranties.

#### 1.5 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, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
  - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
  - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
  - 5. Review structural loading limitations of roof deck during and after roofing.
  - 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
  - 7. Review governing regulations and requirements for insurance and certificates if applicable.
  - 8. Review temporary protection requirements for roofing system during and after installation.

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9. Review roof observation and repair procedures after roofing installation.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: All products specified in this section will be supplied by a single manufacturer with a minimum of twenty (20) years experience.
- B. Installer Qualifications:
  1. All products listed in this section are to be installed by a single installer with a minimum of five (5) years demonstrated experience in installing products of the same type and scope as specified.
  2. Installer must be capable of extending the Manufacturer's Labor and Materials guarantee.
  3. Installer must be capable of extending the Manufacturer's No Dollar Limit guarantee.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

#### 1.8 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. Refer to Carlisle's Roofing System specification, Part II - Application, for General Job Site Considerations.
- C. Safety Data Sheets (SDS) must be on location at all times during the transportation, storage and application of materials.
- D. When positioning membrane sheets, exercise care to locate all field splices away from low spots and out of drain sumps. All field splices should be shingled to prevent bucking of water.
- E. When loading materials onto the roof, the Carlisle Authorized Roofing Applicator must comply with the requirements of the building owner to prevent overloading and possible disturbance to the building structure.
- F. Proceed with roofing work only when weather conditions are in compliance with the manufacturer's recommended limitations, and when conditions will permit the work to proceed in accordance with the manufacturer's requirements and recommendations.
- G. Proceed with work so new roofing materials are not subject to construction traffic. When necessary, new roof sections shall be protected and inspected upon completion for possible damage.
- H. Provide protection, such as 3/4 inch thick plywood, for all roof areas exposed to traffic

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during construction. Plywood must be smooth and free of fasteners and splinters.

- I. The surface on which the insulation or roofing membrane is to be applied shall be clean, smooth, dry, and free of projections or contaminants that would prevent proper application of or be incompatible with the new installation, such as fins, sharp edges, foreign materials, oil and grease.
- J. New roofing shall be complete and weathertight at the end of the work day.
- K. Contaminants such as grease, fats and oils shall not be allowed to come in direct contact with the roofing membrane.

## 1.9 WARRANTY

- A. At project closeout, provide to Owner or Owners Representative an executed copy of the manufacturer's Total-System warranty, outlining its terms, conditions, and exclusions from coverage.

### **New Roof Assembly**

- 1. Warranty: 30yr | 72mph Total System Warranty

### **Cover over Existing Assembly**

- 2. Warranty: 20yr

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
  - 1. Carlisle SynTec Systems
  - 2. Elevate
  - 3. Johns Manville
- B. Requests for substitutions will be considered in accordance with provisions of Section 01.

### 2.2 SCOPE / APPLICATION

- A. Roof System: Provide a waterproof roof system, capable of withstanding uplift forces as specified in Design Criteria.
- B. Base Flashing: Provide a waterproof, fully adhered base flashing system at all penetrations, plane transitions and terminations.

### **New Roof Assembly**

- C. Insulation: Provide a roof insulation system beneath the finish membrane.

### **Cover over Existing Assembly**

- D. Insulation: Provide 1.5" Secure Shield HD Composite mechanically attached through the



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existing membrane and metal deck.

- E. Existing modified bitumen roof and insulation to be left in place. New roof system will be a recover over the existing. All wet or damaged insulation will need to be removed and replaced with the same thickness as the existing material.

## 2.3 MEMBRANE BASE SHEET/VAPOR BARRIER

- A. VapAir Seal MD Air/Vapor Barrier: reinforced composite aluminum foil with self-adhesive SBS backing and removable poly release film. Used for direct application over metal decks.

## 2.4 INSULATION

### **New Roof Assembly**

- A. Polyisocyanurate InsulBase: Carlisle InsulBase. Rigid board with glass fiber reinforced facers (GRF) on both sides, meeting or exceeding the requirements of ASTM C 1289, Type II, Class 1.
  - 1. Compressive Strength: Grade 3 (25 psi) (138 kPa).

### **Cover over Existing Assembly**

- B. Composite Board: Composite insulation panel comprised of 1/2 inch (13 mm) high-density Polyiso cover board laminated during the manufacturing process to SecurShield rigid Polyiso roof insulation meeting ASTM C1289. Carlisle SecurShield HD Composite.
  - 1. Top Layer: ASTM C1289 Type II, Class 4, Grade 1.
  - 2. Compressive Strength: 80 psi min. (751 kPa)
  - 3. Board Thickness: 1/2 inch (13 mm)
  - 4. Bottom Layer: ASTM C1289 Type II, Class 2
  - 5. Compressive Strength: Grade 2 (20 psi) (138 kPa).

## 2.5 COVERBOARD

- A. Moisture-, mold- and impact-resistant, nonstructural fiber-reinforced gypsum panel made from 95 percent recycled materials. Securock, distributed by Carlisle.
  - 1. Board Thickness: 1/2 inch (13 mm).

## 2.6 INSULATION ADHESIVE

- A. Flexible FAST Adhesive: A spray or extruded applied, two-component polyurethane, low-rise expanding foam adhesive used for attaching approved insulations to compatible substrates (concrete, cellular lightweight insulating concrete, gypsum, cementitious wood fiber, wood or steel) or existing smooth or gravel surfaced BUR, modified bitumen or cap sheets.

## 2.7 ETHYLENE, PROPYLENE, DIENE TERPOLYMER (EPDM) MEMBRANE

- A. Sure-Seal Non-Reinforced Membrane: Cured, non-reinforced EPDM membrane meeting the requirements of ASTM D 4637 Type I.
  - 1. Attachment Method: Fully adhered.
  - 2. Color: Black.

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3. Membrane Thickness: 90 mil nominal.
4. Performance:
  - a. Tensile Strength: 1550 psi (10.7 MPa) minimum.
  - b. Tear Resistance: 200 lbf/in (35 kN/m) minimum.
  - c. Elongation: 480 percent.

## 2.8 FLASHING ACCESSORIES

- A. Sure-Seal (black) Pressure-Sensitive Pipe Seals with Factory-Applied TAPE on the deck flange are available for use with Sure-Seal Roofing systems.
- B. Sure-Seal Pressure-Sensitive Pourable Sealer Pocket: Pre-fabricated Pourable Sealer Pocket consisting of a 2 inch (51 mm) wide plastic support strip with Pressure-Sensitive, Factory-Applied, adhesive backed uncured Elastoform Flashing.
- C. Sure-Seal Pressure-Sensitive (PS) Inside/Outside Corner: A 7 inch by 9 inch precut 60-mil thick Elastoform Flashing with a 30-mil Factory-Applied TAPE.
- D. Sure-Seal Pressure-Sensitive Overlayment Strip: A nominal 40-mil black, semi-cured EPDM membrane laminated to a nominal 35-mil cured, Factory-Applied TAPE for flashing gravel stops, metal edgings and Seam Fastening Plates.
- E. Sure-Seal Pressure-Sensitive Cured Cover Strip: Sure-Seal 60-mil cured EPDM membrane laminated to a nominal 35-mil cured Factory-Applied TAPE.
- F. Sure-Seal Pressure-Sensitive "T" Joint Covers: A factory cut uncured 60-mil thick EPDM flashing laminated to a nominal 35-mil Factory-Applied TAPE, used to overlay field splice intersections and to cover field splices at angle changes. Available in 6 inch by 6 inch and 12 inch by 12 inch for Sure-Seal applications, and 6 inch by 6 inch for Sure-White applications.
- G. Sure-Seal Pressure-Sensitive Elastoform Flashing: 60-mil thick uncured EPDM Flashing laminated to a 30-mil Factory-Applied Pressure-Sensitive TAPE used in conjunction with Sure-Seal Primer.
- H. Sure-Seal Pressure-Sensitive RUSS (Reinforced Universal Securement Strip):
  1. 6 inch (152 mm) RUSS: A nominal 6 inch (152 mm) wide

## 2.9 CLEANERS, PRIMERS, ADHESIVES AND SEALANTS

- A. Carlisle Weathered Membrane Cleaner: Clear, solvent-based cleaner used to loosen and remove contaminants from the surface of exposed EPDM membrane prior to applying EPDM Primer.
- B. Sure-Seal SecurTAPE: 3 inch (76 mm) or 6 inch (152 mm) wide by 100 foot (30.5 M) long splice tape used for splicing adjoining sections of EPDM membrane.
- C. Low VOC EPDM and TPO Primer - A low VOC (volatile organic compound) primer (less than 250 grams/liter) for use with SecurTAPE or Pressure-Sensitive products.
- D. Sure-Sealt: A high-strength, butyl-based contact cement which is used for splicing adjoining

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sections of EPDM membrane (cured or uncured).

1. Sure-Seal Splicing Cement: Black splicing cement for use with Sure-Seal (black) Roofing Systems.
- E. Sure-Seal Lap Sealant: A heavy-bodied material (trowel or gun-consistency) used to seal the exposed edges of a membrane splice.
  1. Sure-Seal Lap Sealant: Black sealant for use with Sure-Seal (black) Roofing Systems.
- F. EPDM x-23 Low-VOC Bonding Adhesive: A Low-VOC (volatile organic compound) bonding adhesive (less than 250 grams/liter) used for bonding Sure-Seal/Sure-White EPDM membranes to various surfaces.
- G. Low-VOC Bonding Adhesive: A Low-VOC (volatile organic compound) bonding adhesive (less than 250 grams/liter) used for bonding Sure-Seal/Sure-White EPDM membranes to various surfaces.
- H. Flexible FAST Adhesive: A spray or extruded applied, two-component, polyurethane, low-rise expanding foam adhesive used to securely bond FleeceBACK membranes to a variety of substrates.
- I. Water Cut-Off Mastic: A one-component, low viscosity, self wetting, Butyl blend mastic used as a compression sealing agent between EPDM membranes and applicable substrates.
- J. Two-Part Pourable Sealer: A black, two-component, solvent-free, polyurethane based product used for tie-ins and as a sealant around hard-to-flash membrane penetrating objects such as clusters of pipes and for a daily seal when the completion of flashings and terminations cannot be completed by the end of each work day. Can also be used for attaching lightning rod bases and ground cable clips to the membrane surface.
- K. Sure-Seal One-Part Pourable Sealer: A one-component, moisture curing, elastomeric polyether sealant used as a sealant around hard-to-flash penetrations such as clusters of pipes, and is available in black.
- L. CAV-GRIP III Low-VOC Aerosol Contact Adhesive/Primer: a low-VOC, methylene chloride-free adhesive that can be used for a variety of applications including: Priming unexposed asphalt prior to applying Flexible FAST Adhesive, adhering Sure-Seal EPDM, horizontally, for the field of the roof, and for adhering Sure-Seal FleeceBACK and Sure-Seal EPDM membrane to vertical walls. Coverage rate is approximately 2,000-2,500 sq. ft. per 40 lb cylinder and 4,000-5,000 sq. ft. per 85 lb cylinder as a primer, in a single-sided application and 750 sq. ft. per 40 lb cylinder and 1,500 sq. ft. per 85 lb cylinder as an adhesive for vertical walls, in a double-sided application; 1,000 sq. ft. per 40 lb cylinder and 2,000 sq. ft. per 85 lb cylinder as an adhesive, horizontally, for the field of the roof, in a double-sided application.

## 2.10 FASTENING COMPONENTS

- A. Sure-Seal Termination Bar: 1 inch (13 mm) wide, .098 inch (2.5 mm) thick extruded aluminum bar pre-punched 6 inches (152 mm) on center with sealant ledge to support Lap Sealant.

## PART 3 EXECUTION

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### 3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.2 FIELD QUALITY CONTROL

- A. Roof Moisture Testing for base bid scope: Contractor will engage a qualified independent testing and inspecting agency to perform roof moisture tests and to mark areas of existing roofing where moisture is indicated by testing.
  - 1. Moisture Survey: Testing and inspecting agency will perform an infrared video inspection of entire roof area to identify moist areas.
  - 2. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
    - a. Repair components of roofing system damaged by testing and inspection procedures. Comply with requirements of roofing system manufacturer for cutting and patching roofing, and the following:
      - 1) Coordinate repair work with activities of testing and inspection agency so repairs are performed on same day that roof probes or test cuts are made.
      - 2) Apply supplemental roofing membrane sheet to cover area of repairs and test probes, using sheet not less than 8 inches wider than area of repair, with rounded corner.
  - 3. Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing systems during and after completion of installation and repairs, and submit report to Architect.
    - a. Notify Architect or Owner 3 days in advance of date and time of inspection.

### 3.3 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Do not commence work until all other work trades have completed jobs that require them to traverse the deck on foot or with equipment.
- D. A vapor retarder / temporary roof Carlisle VapAir Seal MD Air & Vapor Barrier) may be applied to protect the inside of the structure prior to the roof system installation.

### 3.4 INSULATION - SYSTEM DESIGN

#### **New Roof Assembly**

- A. Base Layer:
  - 1. Type: Insulbase.
  - 2. Thickness: 2.6"
  - 3. Attachment Method: Loose Laid.

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- B. Top Layer:
  - 1. Type: InsulBase .
  - 2. Thickness: 2.6"
  - 3. Attachment Method: Mechanically Fastened.
- C. Tapered System:
  - 1. Type: InsulBase .
  - 2. Cricket Slope: 1/2" inch per foot.

**Cover over Existing Assembly**

- D. Top Layer:
  - 1. Type: SecurShield HD Composite.
  - 2. Thickness: 1.8 inches.
  - 3. Attachment Method: Mechanically Fastened
- E. Tapered System:
  - 1. Type: crickets.

3.5 INSULATION PLACEMENT

- A. Install insulation or membrane underlayment in multiple layers over the substrate with boards butted tightly together with no joints or gaps greater than 1/4 inch (6 mm). Stagger joints both horizontally and vertically.
- B. Secure insulation to the substrate with the required mechanical fasteners or insulation adhesive in accordance with the manufacturer's current application guidelines.
- C. Do not install wet, damaged or warped insulation boards.
- D. Stagger joints in one direction unless joints are to be taped. Install insulation boards snug. Gaps between board joints shall not exceed 1/4 inch (6 mm). Fill all gaps in excess of 1/4 inch (6 mm) with same insulation material.
- E. Wood nailers must be at least 3 1/2 inches (89 mm) wide or 1 inch (25 mm) wider than adjacent metal flange. Thickness must equal that of insulation but not less than 1 inch (25 mm) thickness.
- F. Miter and fill the edges of the insulation boards at ridges, valleys and other changes in plane to prevent open joints or irregular surfaces. Avoid breaking or crushing of the insulation at the corners.
- G. Do not install any more insulation than will be completely waterproofed each day.

3.6 INSULATION/COVERBOARD ATTACHMENT

- A. 1/2" USG Securock Gypsum-Fiber Board set in Flexible Fast Adhesive
- B. Top Layer of 2.6" 25psi InsulBase mechanically fastened through steel deck.

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- C. Base layer of 2.6" 25psi Insulbase and ½" Tapered 25psi Insulbase Crickets loose laid over steel deck.

### 3.7 MEMBRANE PLACEMENT AND ATTACHMENT (Fully Adhered)

- A. Unroll and position membrane without stretching. Allow the membrane to relax for approximately 1/2 hour before bonding. Fold the sheet back onto itself so half the underside of the membrane is exposed.
- B. Apply the Bonding Adhesive in accordance with the manufacturer's published instructions, to both the underside of the membrane and the substrate. Allow the adhesive to dry until it is tacky but will not string or stick to a dry finger touch.
- C. Roll the coated membrane into the coated substrate while avoiding wrinkles. Brush down the bonded half of the membrane sheet with a soft bristle push broom to achieve maximum contact.
- D. Fold back the unbonded half of the membrane sheet and repeat the bonding procedure.
- E. Install adjoining membrane sheets in the same manner, overlapping edges appropriately to provide for the minimum splice width. It is recommended that all splices be shingled to avoid bucking of water.

### 3.8 MEMBRANE SPLICING (Adhesive Splice)

- A. Fold the top sheet back and clean the dry splice area (minimum 3 inches wide) of both membrane sheets by scrubbing with clean natural fiber rags saturated with Splice Cleaner or HP-250 Primer. When using Sure-Seal (black) PRE-KLEENED membrane, cleaning the splice area is not required unless contaminated with field dirt or other residue.
- B. Apply Splicing Cement in accordance with the manufacturer's current application guidelines, and roll the top sheet onto the mating surface.
- C. Roll the splice with a 2 inch wide steel roller and wait at least 2 hours before applying Lap Sealant to the splice edge following the manufacturer's requirements.
- D. Field splices without In-Seam Sealant must be overlaid with uncured flashing.

### 3.9 MEMBRANE SPLICING (Tape Splice)

- A. Overlap adjacent sheets and mark a line 1/2 inch out from the top sheet.
- B. Fold the top sheet back and clean the dry splice area (minimum 2 1/2 inches (64 mm wide) of both membrane sheets with Sure-Seal Primer as required by the membrane manufacturer.
- C. Where Splice Tape is not Factory-Applied, apply Splice Tape to bottom sheet with the edge of the release film along the marked line. Press tape onto the sheet using hand pressure. Overlap tape roll ends a minimum of 1 inch (13 mm).
- D. Remove the release film and press the top sheet onto the tape using hand pressure.
- E. Roll the seam toward the splice edge with a 2 inch (51 mm) wide steel roller.

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- F. Install Pressure-Sensitive "T" Joint Cover, a 6 inch wide (152 mm) section of Pressure-Sensitive Elastoform Flashing over all field splice intersections.
- G. When using non-Pressure-Sensitive Elastoform Flashing or Elastoform Flashing, seal edges of flashing with Lap Sealant.
- H. The use of Lap Sealant with tape splices is optional except at tape overlaps and cut edges of reinforced membrane where Lap Sealant is required.

### 3.10 FLASHING

- A. Wall and curb flashing shall be cured EPDM membrane. Continue the deck membrane as wall flashing where practicable.
- B. Follow manufacturer's typical flashing procedures for all wall, curb, and penetration flashing including metal edging/coping and roof drain applications.

### 3.11 WALKWAYS

- A. Install walkways at all traffic concentration points (such as roof hatches, access doors, rooftop ladders, etc.) and all locations as identified on the Contract Drawings.
- B. Adhere walkways pads to the EPDM membrane in accordance with the manufacturer's current application guidelines.

### 3.12 DAILY SEALS

- A. On phased roofing, when the completion of flashings and terminations is not achieved by the end of the work day, a daily seal must be performed to temporarily close the membrane to prevent water infiltration.
- B. Use Sure-Seal Pourable Sealer or other acceptable membrane seal in accordance with the manufacturer's requirements.

### 3.13 CLEAN UP

- A. Perform daily clean-up to collect all wrappings, empty containers, paper, and other debris from the project site. Upon completion, all debris must be disposed of in a legally acceptable manner.
- B. Prior to the manufacturer's inspection for warranty, the applicator must perform a pre-inspection to review all work and to verify all flashing has been completed as well as the application of all caulking.

### 3.14 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Formed wall sheet metal fabrications.
  - 2. Formed equipment support flashing.

1.2 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.

1.3 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 for each manufactured product and accessory.
- B. Shop Drawings: For sheet metal flashing and trim.
  - 1. Include plans, elevations, sections, and attachment details.
  - 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 special conditions.
  - 9. Include details of connections to adjoining work.
  - 10. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.



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- C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.
- D. Samples for Verification: For each type of exposed finish.
  - 1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
  - 2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
  - 3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

#### 1.7 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.

#### 1.8 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.
- 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.

## 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 SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. 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, ambient; 180 deg F, 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. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed; with smooth, flat surface.
  - 1. Finish: 2D (dull, cold rolled).

### 2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Self-Adhering, High-Temperature Sheet: Minimum 30 mils 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. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
  - 2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.
- C. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

## 2.4 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 or manufactured item 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 or manufactured item.
  - 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 Stainless-Steel Sheet: Series 300 stainless steel.
- C. Solder:
  - 1. For Stainless Steel: ASTM B 32, Grade Sn60, 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 wide and 1/8 inch thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane 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. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.

## 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.

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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 on slope and location lines indicated on Drawings and within 1/8-inch 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 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 for application, but not less than thickness of metal being secured.
- G. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.
- H. Do not use graphite pencils to mark metal surfaces.

## 2.6 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- long, but not exceeding 12-foot- long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch- high, end dams. Fabricate from the following materials:
1. Stainless Steel: 0.016 inch thick.
- B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch- high, end dams. Fabricate from the following materials:
1. Stainless Steel: 0.016 inch thick.
- C. Wall Expansion-Joint Cover: Fabricate from the following materials:
1. Stainless Steel: 0.019 inch thick.

## 2.7 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following materials:
  - 1. Stainless Steel: 0.019 inch 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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 UNDERLAYMENT INSTALLATION

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.
- B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.
- C. Apply slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

### 3.3 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, solder, 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.

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3. Space cleats not more than 12 inches 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.
- 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 stainless-steel 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 with no joints within 24 inches of corner or intersection.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch 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 into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, 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.
  2. Prepare joints and apply sealants to comply with requirements in Section 079200 "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; however, reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not use torches for soldering.
  2. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
  3. 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.

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Comply with solder manufacturer's recommended methods for cleaning and neutralization.

### 3.4 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 042000 "Unit Masonry."
- C. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

### 3.5 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.
- B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

### 3.6 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### 3.7 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

SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Copings.
  - 2. Gutters.
  - 3. Downspouts.
  - 4. Fascia.
  - 5. Scuppers.
  - 6. Gutter drains.
  - 7. Downspout boots.
- B. Preinstallation Conference: Conduct conference at Project site.

1.2 RELATED SECTIONS

- A. Section 079200 – Joint Sealants: Non-curing sealants.

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.
- 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:
  - 1. Include copings made from 12-inch lengths of full-size components in specified material, and including fasteners, cover joints, accessories, and attachments.
  - 2. All other samples length: Minimum 5-1/2 inches (140 mm).



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1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Product Certificates: For each type of roof specialty.
- C. Product Test Reports: For copings, for tests performed by a qualified testing agency.
- D. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
  - 1. A qualified manufacturer offering products meeting requirements that are SPRI ES-1 tested to specified design pressure.
  - 2. Manufacturer regularly engaged in the manufacturing of materials of similar type to that specified for a minimum of 10 years.
- B. Source Limitations: Obtain roof specialties approved by manufacturer providing roofing-system warranty specified in Section.
- C. Installer's Qualifications:
  - 1. Installer regularly engaged in installation of materials of similar type to that specified for a minimum of 5 years.
  - 2. Use persons trained for installation of materials of similar type to that specified following manufacturer's installation instructions.

1.7 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-specialty installation.
- C. Delivery Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging.
- D. Storage and Handling Requirements:
  - 1. Store and handle materials in accordance with manufacturer's instructions.
  - 2. Keep materials in manufacturer's original, unopened containers and packaging until installation.

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3. Store materials in clean, dry area indoors.
4. Do not store materials directly on floor or ground.
5. Protect materials and finish during storage, handling, and installation to prevent damage.

#### 1.8 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.

#### 1.9 WARRANTY

- A. Warranty Period, Product: 5-year workmanship warranty covering replacement or repair of products that are defective in material or workmanship.
- B. Warranty Period, Finish: Limited 30-year warranty for prefinished coil-coated steel and aluminum coated with Kynar 500 standard colors covering fade, chalk, and film integrity.

### 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. SPRI Wind Design Standard: Manufacture and install copings tested according to SPRI ES-1 and capable of resisting the following design pressures:
  1. Design Pressure: As indicated on Drawings.
- C. 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, ambient; 180 deg F, material surfaces.

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## 2.2 COPINGS

- A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding 12 feet, concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.
1. Manufacturers: Basis of Design Petersen Aluminum Corporation, PAC-Clad, or subject to compliance with requirements, provide products by one of the following:
    - a. Metal-Era, LLC.
    - b. ATAS International, Inc.
    - c. Cheney Flashing Company.
    - d. Hickman Company, W. P.
    - e. Merchant & Evans, Inc.
  2. Formed Aluminum Sheet Coping Caps: Aluminum sheet, thickness as required to meet performance requirements.
    - a. Surface: Smooth, flat finish.
    - b. Finish: Color as indicate on drawings.
  3. Corners: Factory mitered and soldered.
  4. Special Fabrications: Refer to Drawings.
  5. Coping-Cap Attachment Method: Snap-on, fabricated from coping-cap material.
    - a. Snap-on Coping Anchor Plates: Concealed, galvanized-steel sheet, 12 inches wide, with integral cleats.
    - b. Face-Leg Cleats: Concealed, continuous galvanized-steel sheet.

## 2.3 GUTTERS

- A. Metal Gutters:
1. Manufacturers: Basis of Design Petersen Aluminum Corporation, PAC-Clad, or subject to compliance with requirements, provide products by one of the following:
    - a. Metal-Era, LLC.
    - b. ATAS International, Inc.
    - c. Cheney Flashing Company.
    - d. Hickman Company, W. P.
    - e. Merchant & Evans, Inc.
  2. Size: See drawings for dimensions
  3. Approved: FM for wind uplift protection.
  4. Material: 0.050-inch (1.27-mm) aluminum.
  5. Formed Lengths: 12'-0" (3.65 m).
  6. Fastening Holes: Slotted, 12 inches (305 mm) on center.
  7. Lap Joints: 2 inches (51 mm).
  8. Gutter Hangers: 0.100-inch (3-mm) mill aluminum.
  9. Gutter Expansion Joints: Style1, SMACNA design
    - a. Cover Plate Width: 12 inches (305 mm).
    - b. Material: Match gutters.
    - c. Finish: Match gutters.
    - d. Color: Match gutters.
    - e. Pre-slotted Fastening Holes: 2.
  10. Gutter Miters:

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- a. Miter Joints: Prefabricated
- b. Outside miters.
- c. Inside miters.
- 11. Gutter endcaps.
- 12. Fasteners:
  - a. Rivets: 1/8-inch (3-mm) stainless steel color-matched pop rivets.
  - b. Nails: 1-1/4-inch (32-mm) galvanized roofing nails.
  - c. Screws: #10 x 2-inch (51-mm) stainless steel screws.
- 13. Tape: 6-inch (152-mm) wide EPDM/butyl pressure-sensitive tape.

## 2.4 DOWNSPOUTS

### A. Metal Downspouts:

- 1. Manufacturers: Basis of Design Petersen Aluminum Corporation, PAC-Clad, or subject to compliance with requirements, provide products by one of the following:
  - a. Metal-Era, LLC.
  - b. ATAS International, Inc.
  - c. Cheney Flashing Company.
  - d. Hickman Company, W. P.
  - e. Merchant & Evans, Inc.
- 2. Material: 0.050-inch (1.27-mm) aluminum.
- 3. Formed Lengths: 12'-0" (3.65 m).
- 4. Seams: Prefabricated.
- 5. Attachment Straps: Style 1 fasteners concealed behind downspout.
  - a. Width: 2 inches (51 mm).
  - b. Straps per 12-Foot (3.65-m) Downspout Length: 3.
- 6. Standard Elbows: Style B, but coordinate with drawings.
- 7. Offset Elbows: See drawings.
  - a. Material: 0.050-inch (1.27-mm) aluminum.
  - b. Finish: Match downspouts.
  - c. Color: Match downspouts.
- 8. Outlets: 0.040-inch (1.01-mm) aluminum.
  - a. Seams: Prefabricated.

## 2.5 FASCIA

### A. Metal Fascia:

- 1. Manufacturers: Basis of Design Petersen Aluminum Corporation, PAC-Clad, or subject to compliance with requirements, provide products by one of the following:
  - a. Metal-Era, LLC.
  - b. ATAS International, Inc.
  - c. Cheney Flashing Company.
  - d. Hickman Company, W. P.
  - e. Merchant & Evans, Inc.
- 2. Fascia with extruded aluminum anchor bar for single-ply roofing. Minimum thickness 0.040" aluminum fascia cover.
- 3. Face Size: Indicated on the Drawings.

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4. Extruded Anchor Bar:
  - a. Material: Aluminum.
  - b. Thickness: Varies based on face height.
  - c. Extruded Lengths: 12'-0".
  - d. Fastener Holes: Pre-Punched.
5. Anchor Bar Splices:
  - a. Material: EPDM Rubber.
6. Lap Joints
  - a. Material: Same as exterior fascia covers.
  - b. Finish and Color: Same as exterior fascia covers.
  - c. Width: 1".

## 2.6 SCUPPERS

### A. Scupper:

1. Manufacturers: Basis of Design Petersen Aluminum Corporation, PAC-Clad, or subject to compliance with requirements, provide products by one of the following:
  - a. Metal-Era, LLC.
  - b. ATAS International, Inc.
  - c. Cheney Flashing Company.
  - d. Hickman Company, W. P.
  - e. Merchant & Evans, Inc.
2. Size: See drawings for dimensions
3. Through-wall scupper sleeve with downspout collector head.
  - a. Material: Aluminum
  - b. Thickness: .040" aluminum
  - c. Fastener Holes: Pre-Punched.
4. Coordinate flashing with EPDM roof installation.

## 2.7 GUTTER DRAIN

### A. Gutter drain:

1. Manufacturers: Basis of Design Jay R. Smith or subject to compliance with requirements, provide equal for approval.
2. Jay R. Smith, gutter drain, Model 1630T.
3. Duco cast iron body with bronze flashing clamp and bronze top secured with brass screws.

## 2.8 DOWNSPOUT BOOTS

### Downspout boot:

1. Manufacturers: Basis of Design Jay R. Smith or subject to compliance with requirements, provide equal for approval.
2. Jay R. Smith, gutter drain, Model 1785-12-G.
3. Galvanized cast iron body and strap with 5/16"(8) Dia. cast holes for flat head bolts.

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## 2.9 MATERIALS

- A. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.
- B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:

## 2.10 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
  - 1. Thermal Stability: ASTM D 1970/D 1970M; stable after testing at 240 deg F.
  - 2. Low-Temperature Flexibility: ASTM D 1970/D 1970M; passes after testing at minus 20 deg F.
  - 3. Products: Subject to compliance with requirements, provide one of the following:
    - a. Carlisle Coatings & Waterproofing; CCW WIP 300HT.
    - b. Grace Construction Products, a unit of W. R. Grace & Co.; Grace Ice and Water Shield HT.
    - c. Henry Company; Blueskin PE200 HT.
    - d. Metal-Fab Manufacturing, LLC; MetShield.
    - e. Owens Corning; WeatherLock Metal High Temperature Underlayment.
- B. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
- C. Slip Sheet: Rosin-sized building paper, 3-lb/100 sq. ft. minimum.

## 2.11 MISCELLANEOUS MATERIALS

- A. 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.
- B. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.
- C. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.
- D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

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## 2.12 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 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.
- D. Coil-Coated Aluminum Sheet Finishes:
  - 1. Two-coat fluoropolymer.
  - 2. Hylar 5000/Kynar 500.

## 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 where applicable, and securely anchored.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
  - 1. Apply continuously under copings.
  - 2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.
- B. Felt Underlayment: Install with 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.

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### 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, underlayments, 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 weathertight 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. 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 Insert dimension with no joints within 18 inches Insert dimension of corners or intersections unless otherwise indicated on Drawings.
  - 2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.
- D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.
- F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

### 3.4 COPING INSTALLATION

- A. Install 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.



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3.5 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 and sealants.
- C. 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.
- D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures in accordance with manufacturer's instructions and as approved by Architect.

END OF SECTION

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SECTION 077200 - 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.
  - 2. Preformed flashing sleeves.
- B. Related Requirements:
  - 1. Section 055000 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
  - 2. Section 076200 "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 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.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof accessories.
  - 1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

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- 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.
- B. Sample Warranties: For manufacturer's special warranties.

#### 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. Finish Warranty Period: 10 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 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.

#### 2.2 ROOF HATCHES

- A. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, and integrally formed deck-mounting flange at perimeter bottom.
- B. Roof Hatch Type and Size: Thermal Single-leaf lid

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1. Manufacturers: Subject to compliance with requirements, provide products by Babcock Davis as Basis of Design or approved comparable products by one of the following:
    - a. JL Industries.
    - b. Nystrom
    - c. Bilco
    - d. Products that meet material and performance requirements with specified and validated third party testing, are acceptable. "Equal products" shall be required to be pre-submitted and approved.
  2. Model: BRHTA 48X48S1T roof hatch.
  3. Material: Aluminum cover and frame 11 gauge.
  4. Cover: brake formed, hollow metal design with 3" concealed polyisocyanurate insulation, 5" beaded overlapping flange, fully welded at corners and internally reinforced for 40 psi live load.
  5. Curb: 12" high with integral cap flashing, 3" polyisocyanurate insulation, fully welded at corners and 5-1/2" mounting flange with 7/16" holes for securing hatch to deck or blocking.
  6. Gasket: extruded EPDM permanently adhered to cover.
  7. Hinges: Heavy duty pintle hinges with 3/8" type 316 stainless steel hinge pins.
  8. Latch: Enclosed two point slam latch with interior and exterior turn handles and padlock hasps.
  9. Lift Assistance: Compression spring operators enclosed in telescopic tubes. Automatic hold open arm with grip handle release.
  10. Finish: Mill finish aluminum
  11. Hardware: Engineered composite compression spring tubes and steel compression springs packed in grease. Aluminum: Type 316 stainless steel hinges. All other hardware zinc plated chromate sealed.
  12. See drawings for dimensions.
- C. Safety Rail System
1. Manufacturers: Subject to compliance with requirements, provide products by Babcock Davis as Basis of Design or approved comparable products by one of the following:
    - a. JL Industries.
    - b. Nystrom
    - c. Products that meet material and performance requirements with specified and validated third party testing, are acceptable. "Equal products" shall be required to be pre-submitted and approved.
  2. Model: BSRBAY48X48FG
  3. Aluminum powder coated posts and rails 1-1/4" sch. 40 pipe in 6061 T6 aluminum alloy.
  4. Satisfies OSHA 29 CFR 1910.29
  5. Standard self-closing and latching gate feature
  6. Non-penetrating attachment attaches directly to roof hatch cap flashing. Mounting brackets are 6063 T5 aluminum extrusions.
  7. Finish: Safety Yellow
  8. Corrosion warranty of 5 years.
  9. Locking mechanism is cast aluminum spring hinges and all fasteners are type 316 stainless steel.
  10. Top of rail mounted at 42" above finished roofing.
- D. Ladder Safety Post

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1. Manufacturers: Subject to compliance with requirements, provide products by Babcock Davis as Basis of Design or approved comparable products by one of the following:
  - a. JL Industries.
  - b. Nystrom
  - c. Products that meet material and performance requirements with specified and validated third party testing, are acceptable. "Equal products" shall be required to be pre-submitted and approved.
2. Model: BSPA
3. 1-1/2" x 1-1/2" x 1/8" high strength aluminum tubing, Finish milled aluminum, fittings, balancing spring stainless steel constant force spring, hardware T316 stainless steel, Warranty 5 years.

## 2.3 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWWA C2; not less than 1-1/2 inches (38 mm) thick. Also see "Rough Carpentry".
- C. 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 A153/A153M or ASTM F2329.
  2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
  3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
- D. 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.
- E. Sealants: See sealant specification section and use products recommended by the accessory manufacturer and the roof membrane manufacturer.

## 2.4 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. 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, 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. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
- C. Roof Curb Installation: Install each roof curb so top surface is level.
- D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.
- E. Roof-Hatch Installation:
  - 1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
  - 2. Attach safety railing system to roof-hatch curb.
  - 3. Attach ladder-assist post according to manufacturer's written instructions.
  - 4. Elevate hatch onto approved PT blocking and coordinate with roof insulation height.

#### 3.3 REPAIR AND CLEANING

- A. Clean exposed surfaces according to manufacturer's written instructions.

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- B. Clean off excess sealants.
- C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 078100 - APPLIED FIREPROOFING

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 sprayed fire-resistive materials.

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 each type of product.
- B. Shop Drawings: Framing plans or schedules, or both, indicating the following:
  - 1. Extent of fireproofing 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 fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
  - 4. Treatment of fireproofing after application.
- C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard dimensions



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## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Product Certificates: For each type of fireproofing.
- C. Evaluation Reports: For fireproofing, from ICC-ES.
- D. Field quality-control reports.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

## 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 40 deg F (6 deg C) or lower unless temporary protection and heat are provided to maintain temperature at or above this level during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
- B. Source Limitations: Obtain fireproofing for each fire-resistance design from single source.
- C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 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.
  - 2. UL design listings must state that the loading was determined by Allowable Stress Design Method or Load and Resistance Factor Design Method. UL design listings requiring a load restriction factor are not allowed.
- D. Asbestos: Provide products containing no detectable asbestos.

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## 2.2 SPRAYED FIRE-RESISTIVE MATERIALS

- A. Standard Durability SFRM, Interior Locations, Concealed Conditions for Low Rise Buildings: 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. Dry mix inorganic spray-applied fire resistive material containing mineral slag wool and Portland-cement are not permitted.
1. Basis-of-Design Product: Subject to compliance with requirements, provide GCP Applied Technologies ; Monokote MK-6
  2. Bond Strength: Minimum 200-lbf/sq. ft. (9.57-kPa) cohesive and adhesive strength based on field testing according to ASTM E 736.
  3. Density: Not less than density specified in the approved fire-resistance design, according to ASTM E 605.
  4. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E 605, whichever is thicker, but not less than 0.375 inch (9 mm).
    - a. UL design D902, unrestrained assembly rating of 1 Hr.
  5. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 10 or less.
    - b. Smoke-Developed Index: 10 or less.
  6. Compressive Strength: Minimum 10 lbf/sq. in. (68.9 kPa) according to ASTM E 761.
  7. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
  8. Deflection: No cracking, spalling, or delamination according to ASTM E 759.
  9. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
  10. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. (0.270 g/sq. m) in 24 hours according to ASTM E 859.
  11. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G 21.
  12. Sound Absorption: NRC of not less than 0.60 according to ASTM C 423 for Type A mounting according to ASTM E 795.
  13. Finish: Spray-textured finish.

## 2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that are compatible with fireproofing 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 fireproofing 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.

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2. Primer's bond strength in required fire-resistance design complies with specified bond strength for fireproofing 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 E 736.
- C. Bonding Agent: Product approved by fireproofing 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 fireproofing manufacturer's written instructions. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive fireproofing.
- 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 fireproofing manufacturer.
- F. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachment.
- G. Topcoat Sealer: Suitable for application over sprayed fire-resistive material; of type recommended in writing by sprayed fire-resistive material manufacturer for each fire-resistance design.

### 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 fireproofing with substrates under conditions of normal use or fire exposure.
  2. Verify that objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
  3. Verify that substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.
- B. Verify that concrete work on steel deck is complete before beginning fireproofing work.
- C. Verify that roof construction, installation of rooftop HVAC equipment, and other related work are complete before beginning fireproofing work.

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- D. Conduct tests according to fireproofing 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 fireproofing materials during application.
- B. Clean substrates of substances that could impair bond of fireproofing.
- C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.
- 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 fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

### 3.3 APPLICATION

- A. Construct fireproofing 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 fireproofing work.
- B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
  - 1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
  - 2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.
- D. Metal Decks:
  - 1. Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, is completed.

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2. Do not apply fireproofing to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fireproofing.
- E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing 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 fireproofing manufacturer.
- F. Spray apply fireproofing 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 fireproofing manufacturer.
- G. Extend fireproofing in full thickness over entire area of each substrate to be protected.
- H. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.
- I. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply fireproofing that differs in color from that of encapsulant over which it is applied.
- J. Where sealers are used, apply products that are tinted to differentiate them from fireproofing over which they are applied.
- K. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.
- L. Cure fireproofing according to fireproofing manufacturer's written instructions.
- M. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.
- N. Finishes: Where indicated, apply fireproofing to produce the following finishes:
  1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
  2. Spray-Textured Finish: Finish left as spray applied with no further treatment.
  3. Rolled, Spray-Textured Finish: Even finish produced by rolling spray-applied finish with a damp paint roller to remove drippings and excessive roughness.
  4. Skip-Troweled Finish: Even leveled surface produced by troweling spray-applied finish to smooth out the texture and neaten edges.
  5. Skip-Troweled Finish with Corner Beads: Even, leveled surface produced by troweling spray-applied finish to smooth out the texture, eliminate surface markings, and square off edges.

### 3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

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1. Test and inspect as required by Chapter 17 of the applicable building code.
  2. Shop drawings showing the minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly must be obtained from the architect.
- B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
- C. Fireproofing will be considered defective if it does not pass tests and inspections.
1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
  2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
- D. Prepare test and inspection reports.

### 3.5 CLEANING, PROTECTING, AND REPAIRING

- 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.
- B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing is without damage or deterioration at time of Substantial Completion.
- C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.
- D. Repair fireproofing damaged by other work before concealing it with other construction.
- E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Penetrations in fire-resistance-rated walls.
  - 2. Penetrations in horizontal assemblies.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.
  - 1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

- A. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

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1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.
- C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

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."

2.2 MANUFACTURERS

- 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. 3M Fire Protection Products.
  - 2. A/D Fire Protection Systems Inc.
  - 3. Construction Solutions.
  - 4. Grabber Construction Products.
  - 5. Hilti, Inc.
  - 6. HOLDRITE.
  - 7. NUCO Inc.



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8. Passive Fire Protection Partners.
9. RectorSeal.
10. Specified Technologies, Inc.
11. STC Sound Control.
12. Tremco, Inc.

## 2.3 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist 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.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
  1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
  1. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
  2. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
- D. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.
- E. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- F. 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 manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
  1. Permanent forming/damming/backing materials, including the following:
    - a. Slag-wool-fiber or rock-wool-fiber insulation.
    - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    - c. Fire-rated form board.
    - d. Fillers for sealants.
  2. Temporary forming materials.
  3. Substrate primers.
  4. Collars.
  5. Steel sleeves.

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## 2.4 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended 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 elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- 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 of grade indicated below:
  - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

## 2.5 MIXING

- A. For those products requiring mixing before application, comply with penetration firestopping 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.

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## 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: Clean out openings immediately before installing penetration firestopping 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.
  - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form-release agents from concrete.
- B. Priming: 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.
- C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

### 3.3 INSTALLATION

- A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- 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 indicated.
  - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.
- C. Install fill materials for firestopping by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.

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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. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. 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.
- B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.
- C. Proceed with enclosing penetration firestopping 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 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 is 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 and install new materials to produce systems complying with specified requirements.

END OF SECTION

SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Joints in or between fire-resistance-rated constructions.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.

1.4 INFORMATIONAL SUBMITTALS

- A. Installer Certificates: From Installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-resistive joint systems.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing fire-resistive joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its fire-resistive joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

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## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure fire-resistive joint systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

## 1.7 COORDINATION

- A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
- B. Coordinate sizing of joints to accommodate fire-resistive joint systems.
- C. Notify Owner's testing agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on day preceding each series of installations.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
  - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
  - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
    - a. Joint 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."

### 2.2 FIRE-RESISTIVE JOINT SYSTEMS

- A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:
  - 1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.

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2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. A/D Fire Protection Systems Inc.
  - b. CEMCO.
  - c. Fire Trak Corp.
  - d. Grace Construction Products.
  - e. Hilti, Inc.
  - f. Johns Manville.
  - g. Nelson Firestop Products.
  - h. NUCO Inc.
  - i. Passive Fire Protection Partners.
  - j. RectorSeal Corporation.
  - k. Specified Technologies Inc.
  - l. 3M Fire Protection Products.
  - m. Tremco, Inc.; Tremco Fire Protection Systems Group.
  - n. USG Corporation.
- C. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- D. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, 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: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
  1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
  2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
  3. Remove laitance and form-release agents from concrete.

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- B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

### 3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
  - 2. Apply fill materials so they contact and adhere to substrates formed by joints.
  - 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. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system. 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 - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."
  - 2. Contractor's name, address, and phone number.
  - 3. Designation of applicable testing agency.
  - 4. Date of installation.
  - 5. Manufacturer's name.
  - 6. Installer's name.



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3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.
- B. Where deficiencies are found or fire-resistive joint systems are damaged or removed due to testing, repair or replace fire-resistive joint systems so they comply with requirements.
- C. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Silicone joint sealants.
  - 2. Nonstaining silicone joint sealants.
  - 3. Urethane joint sealants.
  - 4. Mildew-resistant joint sealants.
  - 5. Latex joint sealants.
  - 6. Spray foam sealant.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- 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. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint-Sealant Schedule: Include the following information:
  - 1. Joint-sealant application, joint location, and designation.
  - 2. Joint-sealant manufacturer and product name.
  - 3. Joint-sealant formulation.
  - 4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.

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- C. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:
  - 1. Joint-sealant location and designation.
  - 2. Manufacturer and product name.
  - 3. Type of substrate material.
  - 4. Proposed test.
  - 5. Number of samples required.
- D. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
  - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
  - 2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.
- E. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- F. Field-Adhesion-Test Reports: For each sealant application tested.
- G. Sample Warranties: For special warranties.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
  - 1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

## 1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
  - 1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
  - 2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
  - 3. Stain Testing: Use ASTM C 1248 to determine stain potential of sealant when in contact with masonry substrates.
  - 4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
  - 5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  - 6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.

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7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
  1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
  2. Conduct field tests for each kind of sealant and joint substrate.
  3. Notify Architect seven days in advance of dates and times when test joints will be erected.
  4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
    - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
      - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
  6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

#### 1.7 FIELD 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.
  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.

#### 1.8 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
  1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  2. Disintegration of joint substrates from 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 JOINT SEALANTS, 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 joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

### 2.2 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 795.
    - b. GE Construction Sealants; SCS2000 SilPruf.
    - c. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex Sil 265 LTS.
    - d. Pecora Corporation; PCS.
    - e. Sika Corporation U.S.; Sikasil WS-295.
  2. Locations: Exterior non-traffic joints.

### 2.3 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.
- B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 756 SMS.
    - b. GE Construction Sealants; SilPruf NB.

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- c. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex Sil 295 FPS NB.
  - d. Pecora Corporation; 864NST.
  - e. Tremco Incorporated; Spectrem 2.
2. Joints adjacent to masonry or that may drain onto masonry.

#### 2.4 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, T, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Uses T and NT.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. LymTal International, Inc.; Iso-Flex 875R.
  2. Locations: Joints in floor slab.

#### 2.5 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 786-M White.
    - b. GE Construction Sealants; SCS1700 Sanitary.
    - c. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex Sil 100 WF.
    - d. Soudal USA; RTV GP.
    - e. Tremco Incorporated; Tremsil 200.
  2. Interior bathrooms and other wet locations.

#### 2.6 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. BASF Construction Chemicals, LLC, Building Systems; MasterSeal NP 520.
    - b. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex 600.
    - c. Pecora Corporation; AC-20.
    - d. Sherwin-Williams Company (The); 850A.
    - e. Tremco Incorporated; Tremflex 834.
  2. Interior static joints.

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## 2.7 SPRAY FOAM SEALANT

- A. Spray Foam Gap and Crack Sealant: AAMA 812; one- or two-component, foamed-in-place, polyurethane foam with the following characteristics:
  - 1. Density: 2.9 PCF maximum.
  - 2. Surface Burning Characteristics: ASTM E84.
  - 3. Flame Spread Index: 25, maximum.
  - 4. Smoke Developed Index: 450, maximum.
  - 5. Initial R-Value: ASTM C518; 4 per inch thickness, minimum.
  - 6. Maximum Pressure: 1.25 psig.
  - 7. Products:
    - a. The Dow Chemical Company; Great Stuff Pro Window and Door Insulating Foam Sealant.
    - b. Tremco; TremGlaze Low Expansion Polyurethane Foam Sealant.

## 2.8 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Construction Chemicals, LLC, Building Systems.
    - b. Construction Foam Products, a division of Nomaco, Inc.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type O (open-cell material) 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.

## 2.9 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.

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### 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 performance of the Work.
- 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. Unglazed surfaces of ceramic tile.
  - 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.



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### 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. 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.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. 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.
- F. 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.

### 3.4 SPRAY FOAM SEALANT INSTALLATION

- A. Install spray foam sealant in accordance with manufacturer's instructions.
- B. Fill cracks and gaps at wall framing openings to provide continuous thermal barrier.
- C. Install foam without causing deflection in adjacent window and door frames in excess of allowable tolerances for proper operation and performance of windows and doors.
- D. Trim excess foam flush with adjacent surfaces.

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### 3.5 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
  - 1. Extent of Testing: Test completed and cured sealant joints as follows:
    - a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
    - b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
  - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
    - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  - 3. Inspect tested joints and report on the following:
    - a. Whether sealants filled joint cavities and are free of voids.
    - b. Whether sealant dimensions and configurations comply with specified requirements.
    - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
  - 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
  - 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

### 3.6 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.

### 3.7 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

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or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

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SECTION 079219 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acoustical joint sealants.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for elastomeric, latex, and butyl-rubber-based joint sealants for non acoustical applications.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Acoustical joint sealants.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants, showing full range of available colors for each product exposed to view.

C. Samples for Verification: For each type and color of acoustical joint sealant required.

1. Size: 1/2-inch- wide sealant joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Acoustical Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.3 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports:

1. Product Test Reports: For each type of acoustical joint sealant, for tests performed by qualified testing agency.

B. Sample warranties.

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#### 1.4 CLOSEOUT SUBMITTALS

- A. Warranty Documentation:
  - 1. Manufacturers' special warranties.
  - 2. Installer's special warranties.

#### 1.5 WARRANTY

- A. Installer's Special Warranty: Installer agrees to repair or replace acoustical joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Manufacturer's Special Warranty: Manufacturer agrees to furnish acoustical joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: the manufacturers standard warranty.

### PART 2 - PRODUCTS

#### 2.1 ACOUSTICAL JOINT SEALANTS

- A. Acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies in accordance with ASTM E90.
- B. For partitions that have GWB rigidly attached to framing: Use a sealant that provides at least 12.5% movement per ASTM C719
  - 1. Acceptable Manufacturers
    - a. Hilti Smoke and Acoustic Sealant (non-fire-rated)
    - b. 3M FD 150+ (fire-rated)
- C. For partitions that have GWB resiliently attached to framing (stud isolation clips, resilient channel, spring hangers, etc.), use a sealant that provides at least 25% movement per ASTM C719.
  - 1. Acceptable Manufacturers
    - a. Sikaflex-Textured (non-fire-rated)
    - b. USG Sheetrock Brand Acoustical Sealant (fire-rated)
    - c. SikaFlex-15LM (fire-rated)

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- D. Oversize penetrations by 1/2" (such as those for ductwork or piping) so that the penetrating element does not contact the wall, roof, or floor/ceiling assembly. Fill the resulting gap with backer rod and caulk with a resilient, non-hardening sealant.
- E. Fill Penetrations with gaps larger than 1/2" (such as those for beams, large conduit, ductwork drops from rooftop units) with fire-stop putty equivalent to Hilti CP 618.
- F. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

## 2.2 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by acoustical joint-sealant manufacturer where required for adhesion of sealant to joint substrates.
- 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 acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, 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. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where recommended by acoustical joint-sealant manufacturer. 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

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by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

- A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.
- B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written instructions for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.
- C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

### 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 acoustical joint sealants and of products in which joints occur.

### 3.5 PROTECTION

- A. Protect acoustical 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, remove, and repair damaged or deteriorated acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 079500 - EXPANSION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Expansion control systems.

1.2 ACTION SUBMITTALS

- A. Shop Drawings: For each expansion control system specified. Include plans, elevations, sections, details, splices, blockout requirement, attachments to other work, and line diagrams showing entire route of each expansion control system. Where expansion control systems change planes, provide isometric or clearly detailed drawing depicting how components interconnect.
- B. Samples for Verification: For each type of expansion control system indicated, full width by 6 inches long in size.
- C. Product Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
  - 1. Manufacturer and model number for each expansion control system.
  - 2. Expansion control system location cross-referenced to Drawings.
  - 3. Nominal joint width.
  - 4. Movement capability.
  - 5. Classification as thermal or seismic.
  - 6. Materials, colors, and finishes.
  - 7. Product options.
  - 8. Fire-resistance ratings.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each fire barrier provided as part of an expansion control system, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. General: Provide expansion control systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.



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1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where expansion control systems change direction or abut other materials.
2. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion control systems.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Where indicated, provide expansion control systems with fire barriers identical to those of systems tested for fire resistance per UL 2079 or ASTM E 1966 by a testing and inspecting agency acceptable to authorities having jurisdiction.
  1. Hose Stream Test: Wall-to-wall and wall-to-ceiling systems shall be subjected to hose stream testing.
- B. Seismic Performance: Expansion control systems 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 is 1.0.

## 2.3 EXTERIOR EXPANSION CONTROL SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products as manufactured by MM Systems Corporation as Basis of Design or approved comparable products.
- B. Walls Above Grade:
  1. Basis of Design: Emseal Joint Systems Ltd.; Seismic Colorseal.
  2. Design Criteria: As indicated on Drawings.
  3. Configuration:
    - a. Acrylic-infused cellular polyurethane foam with factory-applied silicone face bellows.
    - b. Color as selected by Architect from manufacturer's full range.
- C. Exterior Roof to Wall Joint Systems:
  1. Basis of Design: Provide expansion control as indicated on drawings to meet roof manufacturer's warranty requirements.
  2. Design Criteria: As indicated on Drawings.
  3. Fire Resistance: Equal to or greater than adjacent assemblies where required.

## 2.4 MATERIALS

- A. Aluminum: ASTM B 221, Alloy 6063-T5 for extrusions; ASTM B 209, Alloy 6061-T6 for sheet and plate.

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1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
- B. Elastomeric Seals: ASTM E 1783; preformed elastomeric membranes or extrusions to be installed in metal frames.
- C. Compression Seals: ASTM E 1612; preformed elastomeric extrusions having an internal baffle system and designed to function under compression.
- D. Cellular Foam Seals: Extruded, compressible foam designed to function under compression.
- E. Elastomeric Concrete: Modified epoxy or polyurethane extended into a prepackaged aggregate blend, specifically designed for bonding to concrete substrates.
- F. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required fire-resistance rating.
- G. Moisture Barrier: Flexible elastomeric material, PVC, minimum 30 mils thick.
- H. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
- I. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

## 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. 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.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces where expansion control systems will be installed for installation tolerances and other conditions affecting performance of work.

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1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to expansion control system manufacturer's written instructions.
- B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion control systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion control systems.
- C. Cast-In Frames: Coordinate and furnish frames to be cast into concrete.

### 3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion control systems and materials unless more stringent requirements are indicated.
- B. Compression Seals: Apply adhesive or lubricant adhesive as recommended by manufacturer to both sides of slabs before installing compression seals.
- C. Foam Seals: Install with adhesive recommended by manufacturer.
- D. Terminate exposed ends of expansion control systems with field- or factory-fabricated termination devices.
- E. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion control system materials and associated work so complete assemblies comply with assembly performance requirements.
  1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

### 3.4 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion control systems. Reinstall cover plates or seals prior to Substantial Completion of the Work.

END OF SECTION

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Results:
  - 1. Interior heavy-duty hollow metal doors and frames at locations indicated on the Drawings.
  - 2. Interior attack resistant opening with heavy-duty hollow metal doors and frames at locations indicated on the Drawings.
  - 3. Exterior extra-heavy-duty hollow metal doors and frames at locations indicated on the Drawings.
  - 4. Exterior attack resistant retrofit kit extra-heavy-duty hollow metal doors and extra-heavy-duty frames at locations indicated on the Drawings.
- B. Principal Products:
  - 1. Hollow metal doors.
  - 2. Hollow metal frames.

1.2 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.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- 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.

- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification:
  - 1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
  - 2. For "Doors" and "Frames" subparagraphs below, prepare Samples approximately 12 by 12 inches to demonstrate compliance with requirements for quality of materials and construction:
    - a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
    - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.
- E. 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.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

## 1.6 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 nonvented 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-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
  - 1. Assa Abloy as basis of design.
  - 2. Curries Company; an Assa Abloy Group company.
  - 3. Pioneer Industries, Inc.; an Assa Abloy Group company.

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4. Republic Doors and Frames, an Allegion Company.
5. Steelcraft; an Allegion company.

B. Source Limitations:

1. 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.
- 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.

2.3 INTERIOR DOORS

- 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. Doors: SDI A250.8, Level 2, heavy-duty. At locations indicated in the Door and Frame Schedule.
  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.
    - c. Face: Metallic-coated, cold-rolled steel sheet, minimum thickness of 0.067 inch.
    - d. Edge Construction: Model 2, Seamless.
    - e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
  3. Frames:
    - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch.
    - b. Construction: Full profile welded.
  4. Exposed Finish: Prime .

2.4 EXTERIOR HOLLOW-METAL DOORS

- 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: SDI A250.8, Level 3, extra-heavy-duty. At locations indicated in the Door and Frame Schedule.

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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
  - c. Face: Metallic-coated steel sheet, minimum thickness of 0.067 inch, with minimum A40 galvanized coating.
  - d. Edge Construction: Model 2, Seamless .
  - e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
    - 1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value U-factor of not more than 0.61 when tested according to ASTM C 1363.
3. Frames:
  - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch, with minimum A40 coating.
  - b. Construction: Full profile welded.
4. Exposed Finish: Prime.

## 2.5 FRAMES

- A. Frames: SDI A250.8, Level 3.
  1. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch.
  2. Construction: Welded.
  3. Exposed Finish: Prime.

## 2.6 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 thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
  2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
  3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
  4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
  1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
  2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

## 2.7 MATERIALS

- A. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- B. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z 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.
- C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- D. 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.
- E. 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.
- F. Glazing: Comply with requirements in Section 088000 "Glazing."

## 2.8 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, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches 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: Provide beveled or square edges at manufacturer's discretion.
  - 4. Top Edge Closures: Close top edges of doors with inverted closures of same material as face sheets.
  - 5. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
  - 6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- 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 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 from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
      - 1) Two anchors per jamb up to 60 inches high.
      - 2) Three anchors per jamb from 60 to 90 inches high.
      - 3) Four anchors per jamb from 90 to 120 inches high.
      - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
    - b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      - 1) Three anchors per jamb up to 60 inches high.
      - 2) Four anchors per jamb from 60 to 90 inches high.
      - 3) Five anchors per jamb from 90 to 96 inches high.
      - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
    - c. Compression Type: Not less than two anchors in each frame.
    - d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
  6. 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.
  7. Terminated Stops: Terminate stops 6 inches above finish floor with a 45-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
- 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.
  2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

- F. Stops and Moldings: Provide stops and moldings around glazed lites 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.

## 2.9 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.

## 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 nontemplated, 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. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
  - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled 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. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
  - 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  - 7. 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, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch, 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 plus or minus 1/32 inch.
    - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
    - c. At Bottom of Door: 5/8 inch plus or minus 1/32 inch.
    - d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

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2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Glazing: Comply with installation requirements in Section 088000 "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 o.c. and not more than 2 inches 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.

END OF SECTION

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Wood doors hung in hollow metal frames at locations indicated on Drawings.

B. Principal Products:

1. Solid core wood doors.
2. Glazed light frames.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of door.

1. Core, edge, and face construction.
2. Glazing trim materials.
3. Finishing materials and systems.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; and construction details.

1. Blocking sizes and locations.
2. Hardware preparation sizes and locations.
3. Glazing sizes and locations.
4. Factory finishes.
5. Fire-protection ratings.

C. Samples for Initial Selection:

1. Factory-finished doors.

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. Door corner sections, approximately 8 by 10 inches, showing door faces, crossbands, core, and edges.
  - a. Provide Samples for each species of veneer and solid lumber.
  - b. Finish veneer-faced door Samples with same materials proposed for factory-finished doors.

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3. Glazed light frames, 6 inches long, for each material, type, and finish.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.
- B. Quality Standard Compliance Certificates: AWI Quality Certification.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
  1. Certified participant in AWI's Quality Certification Program.

#### 1.6 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.

#### 1.7 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.

#### 1.8 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 in a 42-by-84-inch section.
    - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
  2. Warranty Period for Solid-Core Interior Doors: Life of installation.

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## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eggers Industries.
  - 2. Masonite Architectural.
  - 3. TruStile.
  - 4. VT Industries, Inc.
- B. Source Limitations: Obtain flush wood doors from single manufacturer.

### 2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard:
  - 1. WDMA I.S.1-A, "Architectural Wood Flush Doors.
  - 2. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.
- B. WDMA I.S.1-A Performance Grade: Heavy Duty, minimum.
- C. 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 or UL 10C.
  - 1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
  - 2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
  - 3. 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.
- D. Structural-Composite-Lumber-Core Doors:
  - 1. Structural Composite Lumber: WDMA I.S.10.
    - a. Screw Withdrawal, Face: 700 lbf.
    - b. Screw Withdrawal, Edge: 400 lbf.
- E. 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.
  - 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.

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- a. Screw-Holding Capability: 550 lbf per WDMA T.M.-10.

## 2.3 INTERIOR SOLID CORE WOOD DOORS

- A. Door Grade:
  - 1. Premium, with Grade A faces.
- B. Veneer Species:
  - 1. Select hard white maple.
- C. Veneer Cut:
  - 1. Plain sliced (flat sliced).
- D. Match between Veneer Leaves:
  - 1. Book match.
- E. Assembly of Veneer Leaves on Door Faces: Balance match.
- F. Pair and Set Match: Provide for doors hung in same opening.
- G. Exposed Vertical and Top Edges: Same species as faces or a compatible species - edge Type A.
- H. Core:
  - 1. Structural composite lumber.
  - 2. Mineral core when required for fire resistance rating.
- I. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering.

## 2.4 GLAZED LIGHT FRAMES

- 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: Flush rectangular beads.

## 2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting.
  - 1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
  - 1. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.



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- C. Openings: Factory cut and trim openings through doors.
  - 1. Glazed Light Openings: Trim openings with specified moldings.
  - 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with Section 088000 "Glazing."

## 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 that are indicated to receive transparent finish.
- C. Transparent Finish:
  - 1. Grade: Premium.
  - 2. Finish: AWT's, AWMAC's, and WI's "Architectural Woodwork Standards" System 11, catalyzed polyurethane.
  - 3. Staining: None required.
  - 4. 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 087100 "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.
- C. Align in frames for uniform clearance at jamb and head edges.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

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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

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Results:
  - 1. Access doors and frames.
- B. Principal Products:
  - 1. Flush Access Doors with Concealed Flanges.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details materials, individual components and profiles, and finishes.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, details, and attachments to other work.
  - 2. Detail fabrication and installation of access doors and frames for each type of substrate.
- C. Samples: For each door face material, at least 3 by 5 inches in size, in specified finish.
- D. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics according to the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
  - 2. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:
  - 1. Nystrom, Inc as basis of design.

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2. Acudor Products, Inc.
3. Babcock-Davis.
4. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
5. Karp Associates, Inc.
6. Larsen's Manufacturing Company.
7. Milcor Inc.

B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

C. Basis of Design Product: Interior Drywall Model IW-K, hinged door Access Doors:

1. Description: Insulated Access Door provides access through openings in fire-rated walls or ceilings.
2. Locations: As indicated on Drawings.
3. Door Size: As indicated on Drawings.
4. Door Material: 14 ga steel
5. Frame Material: 16 ga steel
6. Hinges: Concealed pin.
7. Latch and Lock: key operated latch bolt unless otherwise indicated.

D. Basis of Design Product: Interior Drywall Model NW-L, hinged door Access Doors:

1. Description: Insulated Access Door provides access through openings in non-rated walls or ceilings.
2. Locations: As indicated on Drawings.
3. Door Size: As indicated on Drawings.
4. Door Material: 14 ga steel
5. Frame Material: 16 ga steel
6. Hinges: Flush continuous piano.
7. Latch and Lock: key operated cam latch unless otherwise indicated.

## 2.3 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Frame Anchors: Same type as door face.
- D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

## 2.4 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 attachment devices and fasteners of type required to secure access doors to types of supports indicated.
  - 1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
  - 2. Provide mounting holes in frames for attachment of units to metal or wood framing.
  - 3. Provide mounting holes in frame for attachment of masonry anchors.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

## 2.5 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. Steel and Metallic-Coated-Steel Finishes:
  - 1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

## 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.

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3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 083323 - ROLLING COUNTER DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Rolling Counter Doors, manually operated.

1.2 RELATED SECTIONS

- A. Section 055000 - Metal Fabrications: Support framing and framed opening.
- B. Section 087100 - Door Hardware: Product Requirements for cylinder core and keys.

1.3 REFERENCES

- A. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM A 666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- C. ASTM A 924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- D. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Details of construction and fabrication.
  - 4. Installation methods.
- C. Shop Drawings: Include detailed plans, elevations, details of framing members, required clearances, anchors, and accessories. Include relationship with adjacent construction.
- D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and patterns.

- F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in performing Work of this section with a minimum of five years experience in the fabrication and installation of security closures.
- B. Installer Qualifications: Company specializing in performing Work of this section with minimum three years and approved by manufacturer.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.
- C. Store materials in a dry, warm, ventilated weathertight location.

#### 1.7 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.

#### 1.8 COORDINATION

- A. Coordinate Work with other operations and installation of adjacent finish materials to avoid damage to installed materials.

#### 1.9 WARRANTY

- A. Warranty: Manufacturer's limited door warranty for 2 years for all parts and components.
- B. PowderGuard Finish.
  - 1. PowderGuard Premium Applied to curtain, guides, bottom bar, headplates: Manufacturer's limited Premium Finish warranty for 2 years.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturer: Basis of Design, Overhead Door Corporation, or subject to compliance with requirements, provide products by one of the following:



- a. Cornell Cookson, LLC.
- b. Clopay Corporation.

## 2.2 ROLLING STEEL COUNTER DOORS

- A. Counter Doors: Overhead Door Corporation 650 Series.
  - 1. Wall Mounting Condition:
    - a. Face-of-wall mounting.
  - 2. Curtain: Interlocking slats, Type F-158 fabricated of anodized aluminum. Endlocks attached to alternate slats to maintain curtain alignment and prevent lateral slat movement.
  - 3. Finish: Galvanized steel primed with powder coat finish as selected by architect from standard colors.
  - 4. Bottom Bar: Extruded aluminum tubular shape with astragal.
  - 5. Guides: Extruded aluminum.
  - 6. Brackets: Steel plate to support counterbalance, curtain and hood.
  - 7. Finish; Bottom Bar, Guides, Brackets:
    - a. Finish: Powder coat, color to match curtain.
  - 8. Counterbalance: Helical torsion spring type housed in a steel tube or pipe barrel.
  - 9. Hood: Provided with intermediate support brackets as required and fabricated of Aluminum.
  - 10. Operation:
    - a. Crank operation.
  - 11. Locking:
    - a. Two point dead locks with mortise cylinders.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify opening sizes, tolerances and conditions are acceptable.
- B. Examine conditions of substrates, supports, and other conditions under which this work is to be performed.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.

- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Coordinate installation of electrical service with Section 16150. Complete wiring from disconnect to unit components.
- F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 079200.
- G. Install perimeter trim and closures.

### 3.4 ADJUSTING

- A. Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.
- B. Adjust hardware and operating assemblies for smooth and noiseless operation.

### 3.5 CLEANING

- A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.
- B. Remove labels and visible markings.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

### 3.6 PROTECTION

- A. Protect installed products until completion of project.

END OF SECTION

## SECTION 083500 - SIDE-FOLDING GRILLES

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Aluminum, manually operated, side-folding grilles.
- B. Related Sections:
  - 1. 055000 Metal Fabrications. Structural support for track.
  - 2. 061000 Rough Carpentry. Structural support for track.
  - 4. 087000 Hardware.

#### 1.2 SUBMITTALS

- A. Reference Section 013300 Submittal Procedures; submit the following items:
  - 1. Product Data.
  - 2. Shop Drawings: Include special conditions not detailed in Product Data. Show interface with adjacent work.
  - 3. Quality Assurance/Control Submittals:
    - a. Provide proof of manufacturer and installer qualifications – see 1.3 below.
    - b. Provide manufacturer's installation instructions.
  - 4. Closeout Submittals:
    - a. Operation and Maintenance Manual.
    - b. Certificate stating that installed materials comply with this specification.

#### 1.3 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Manufacturer Qualifications: Minimum of five years experience in producing side-folding grilles of the type specified.
  - 2. Installer Qualifications: Manufacturer's approval.

#### 1.4 DELIVERY STORAGE AND HANDLING

- A. Follow manufacturer's instructions.

#### 1.5 DESIGN / PERFORMANCE REQUIREMENTS

- A. Stacking:
  - 1. Minimum stacking shall be 1.05 inches/linear foot (87.5 mm/meter) of opening plus 3.5 inches (89 mm) for each locking member.
  - 2. Grille support must be designed to carry the weight of a fully stacked door at any point along its length. Support is to carry the total weight / the total stacking and is express as lbs. per linear ft.

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- B. Lintel Deflection: Accommodate deflection of lintel to prevent damage to components, deterioration of seals, or movement between door frame and perimeter framing.
- C. Thermal Movement: Design sections to permit thermal expansion and contraction of components to match perimeter opening construction.

## 1.6 WARRANTY

- A. Standard Warranty: Two years from date of shipment against defects in material and workmanship.
- B. Maintenance: Submit for owner's consideration and acceptance of a maintenance service agreement for installed products.

## 1.7 System Description

- 1. Custom Layout
  - a. Product has been reconfigured for a custom layout, refer to drawings by CornellCookson.
- 2. Customized Product
  - a. This product has custom modifications designed by CornellCookson. Contact Manufacturer for details.

## PART 2 PRODUCTS

### 2.1 MANUFACTURER

- A. Manufacturers: Basis of Design, Cornell - 24 Elmwood Avenue, Mountain Top, PA 18707, Telephone: (800) 233-8366, or subject to compliance with requirements, provide products by one of the following:
  - a. Overhead Door
  - b. Metro Door, LLC
  - c. Wayne Dalton
- B. Model: ESG32 – GlideGard

### 2.2 MATERIALS

- A. Curtain:
  - 1. Vertical Tubes: 5/16 inch (8 mm) diameter, 6063 T5 aluminum alloy, 3.5 inches (89 mm) on center.
  - 2. Tube Spacers: 7/16 inch (11 mm) outside diameter aluminum tubes to maintain horizontal chain spacing.
  - 3. Horizontal Bars: Aluminum bars, 6 inches x 3/4 inch (152 mm x 19 mm), Bars to be vertically spaced at 9 inches (229 mm) o.c. in a brick pattern.

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4. Hinge Panels: 2 inch (51 mm) high continuous interlocking aluminum panels at the top and bottom of the closure.
  5. Leading End Member: 1 5/16 x 2 3/8 x 1/8 inch (33 x 60 x 3 mm) thick extruded aluminum tube with recess for attaching curtain sections.
    - a. Provide concealed masterkeyable, cylinder operated hook-bolt #7 member with lock operable from both sides of curtain that engages a full height wall channel. Provide rubber bumper at the edge of the locking member.
  6. Intermediate Member(s): 1 5/16 x 2 3/8 x 1/8 inch (33 x 60 x 3 mm) thick extruded aluminum tube with recess for attaching curtain sections.
  7. Trailing End Member: 1 5/16 x 2 3/8 x 1/8 inch (33 x 60 x 3 mm) thick extruded aluminum tube with recess for attaching curtain sections.
    - a. Provide #8 fixed end member.
- B. Trolleys: 1 1/8 inch (29 mm) diameter nylon tired ball bearing wheels; two wheel assembly at each hanger; three wheel assembly at all vertical members.
- C. Track: 1.3 x 1.8 inch (33 x 46 mm) thick extruded aluminum section with continuous recess for splice tongues and pins.
- D. Finishes: Dark bronze anodized

## 2.3 ACCESSORIES

- A. Pocket Door(s):
1. Door
    - a. Material: A36 HR steel
    - b. Thickness: USS 12-gauge
    - c. Finish: Phosphate treatment followed by a light gray baked-on polyester powder coat; minimum 2.5 mils (0.065 mm) cured film thickness.
    - c. Finish: Phosphate treatment followed by a baked-on polyester powder coat, color as selected from manufacturer's standard color range, minimum 32 colors; minimum 2.5 mils (0.065 mm) cured film thickness; ASTM-D-3363 pencil hardness: H or better.
    - d. Size: Rough opening minus 13/16" (20.6 mm)
  2. Frame
    - a. Material: A36 HR steel
    - b. Thickness: USS 12-gauge steel
    - c. Finish: Phosphate treatment followed by a light gray baked-on polyester powder coat; minimum 2.5 mils (0.065 mm) cured film thickness.
    - c. Finish: Phosphate treatment followed by a baked-on polyester powder coat, color as selected from manufacturer's standard color range, minimum 32 colors; minimum 2.5 mils (0.065 mm) cured film thickness; ASTM-D-3363 pencil hardness: H or better.
    - d. Size: Overlaps opening 2" (50.8 mm) with a 5/8" (15.9 mm) projection off wall
  3. Hinges: 3" (76.2 mm) non-mortise type

4. Lock: 1" (25.4 mm) security mortise cylinder

## 2.4 FABRICATION

- A. Fabricate with every fourth vertical rod as a hanger rod. Provide tube spacers at each hanger rod to maintain chain spacing.
- B. Hinge Panels: Continuous rows between top two and bottom two chain sets.
- C. Intermediate Members: Spacing not to exceed 13 feet (3.05 M) on center.
- D. Bi-Parting Grilles: Attach strike channel to appropriate curtain section.

## 2.5 OPERATION

- A. Manual push-pull.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine header substrates upon which side-folding grilles will be installed and verify conditions are in accordance with approved shop drawings. Header, floor or sill to be level across entire grille opening.
- B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates and floor or sill levels.
- C. Commencement of work by installer is acceptance of substrate.

### 3.2 INSTALLATION

- A. General: Install side-folding grille with necessary hardware, anchors, inserts, hangers and supports.
- B. Follow manufacturer's installation instructions.

### 3.3 ADJUSTING

- A. Following completion of installation, including related work by others, lubricate, test, and adjust side-folding grilles for ease of operation.

### 3.4 CLEANING

- A. Clean surfaces soiled by work as recommended by manufacturer.

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- B. Remove surplus materials and debris from the site.

### 3.5 DEMONSTRATION

- A. Demonstrate proper operation to Owner's Representative.
- B. Instruct Owner's Representative in maintenance procedures.

END OF SECTION

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**SECTION 08 35 13.23 ACCORDION-FOLDING FIRE DOORS (+ OPTIONAL ACCESS CONTROL)**

**PART 1 – GENERAL**

**1.01 SUMMARY OF WORK**

- A. Division 0 and 1, as indexed, apply to this section.
- B. Furnish and install all horizontal-sliding accordion-folding fire doors shown on the drawings and specified herein.

**1.02 RELATED SECTIONS**

- A. All headers, support structures, fire protection of support structures, surrounding insulation, jambs, storage pockets, blocking and trim shall be furnished and installed by other sections.
- B. All electrical wire, wiring, conduit and electrical boxes shall be furnished and installed by electrical section including connections to smoke detectors and building fire and access control alarm panels.

**1.03 QUALITY ASSURANCE**

- A. Installation shall be performed by factory trained and certified installers with experience installing electrically operated accordion folding fire doors.
- B. Fire doors shall be listed by Underwriters Laboratories for ratings as indicated, when tested in accordance with the requirements of UL 10B and NFPA 252.
- C. Automatic closing system shall be listed by Underwriters Laboratories in accordance with the requirements of UL 864 and UL 294, and in compliance with NFPA 80.
- D. Fire doors used for smoke and draft control shall bear the “S” mark on the fire door UL label and shall have an air leakage of less than 3 CFM/ft<sup>2</sup> at 0.1 inch of water column pressure when tested in accordance with UL 1784 with an artificial bottom seal.
- E. Fire doors used at the point of access to an elevator or elevator lobbies used by fire service personnel for evacuations shall bear the “S” mark on the UL fire door label and shall have an air leakage of less than 3 CFM/ft<sup>2</sup> at 0.1 inch of water column pressure when tested in accordance with UL 1784 without an artificial bottom seal.
- F. Fire Doors shall be capable of resisting an air pressure differential up to 0.05 inches of water column. Optional air pressure resistance up to 0.15 inches of water column available. (See 2.05 H)

**1.04 SUBMITTALS**

- A. See Section 01 30 00 – Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer’s technical literature, include UL listing data.
- C. Shop Drawings: Indicate construction and installation details and dimensions, including layout, electrical requirements, required stack depth, height of header above finished floor, and requirements for anchorage and support of each door.
- D. Operation and Maintenance Data: Operating procedures, troubleshooting and repair methods, and wiring diagrams.



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1.05 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's agent will deliver original, unopened packages to a location designated by the General Contractor. All packages must be stored indoors, protected from moisture damage and secure from theft or other damage. General Contractor to note any damage or shortages at time of delivery.

1.06 COORDINATION BY GENERAL CONTRACTOR

- A. Coordinate with the following:
  - 1. Fire Alarm system.
  - 2. Electrical.
  - 3. Pocket cover doors.
  - 4. Floor and ceiling finish.
- B. Assure accurate installation of header, jamb, and trim. Provide "As-Built" dimensions for opening and storage pocket. Supervise unloading and handling of materials.
- C. Store boxes flat (not more than three high) in a protected dry area.
- D. Permanent power shall be in-place and ready for final connection when fire and access control doors are installed. Assure access to and proper clearance for motor operators.
- E. After testing the fire alarm system, automatic-closing fire doors shall be re-set to the original position.

1.07 WARRANTY

- A. Materials and installation shall be warranted against defects in workmanship for a period of two (2) years from the date of substantial completion.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. Horizontal-sliding, accordion-folding, fire doors as manufactured by Won-Door Corporation shall be specified as the following:

Won-Door FireGuard 60

- B. No substitutions allowed.

2.02 ACCORDION FIRE DOORS – GENERAL

- A. Provide electrically powered self-closing fire doors of configurations indicated on the drawings.
  - 1. Fire rating as required.
- B. Fire Rating – Fire doors shall be listed by Underwriters Laboratory as special purpose fire doors having a 60 minute fire protection rating in accordance with the requirements of UL 10B and NFPA 252.
- C. Single Parting

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- D. Closing and Opening Operation: Automatic Closing System, listed to UL864 including motor operator and releasing devices shall be a Microprocessor-based system and shall commence closing upon activation by fire signal, access control signal, low battery voltage or optional low AC voltage.
  - 1. Obstruction Detection: Contact with an obstruction shall cause the door to stop, reverse enough to remove pressure on the leading edge, pause, and then re-close when in an alarm condition.
  - 2. Constant pressure to the leading edge while not under motor power shall prevent motor operation and allow the door to be opened manually.

## 2.03 COMPONENTS

- A. Door Construction: Two parallel, accordion-type walls independently suspended with no floor tracks or pantographs.
  - 1. Panels: 24-gauge steel, V-grooved; modular in design; capable of in-place repair.
  - 2. Perimeter Seals: shall consist of continuous extruded sweeps attached to the top and bottom of the fire door to form a smoke and draft seal.
  - 3. Hanging Weight: 5.5 pounds per sq. ft when extended across opening.
  - 4. Finish: All steel panels shall have factory-applied protective coatings.
  - 5. Color: Manufacturer's standard platinum.
- B. Suspension System: Two tracks, on 8- or 10-inch centers, attached to overhead structural support.
  - 1. Track: 14-gauge cold rolled steel or 1/8" Aluminum extrusion.
  - 2. Panel Hangers: Panels shall be suspended by a steel hanger pin and ball bearing roller system.
  - 3. Narrow Lead Post Hangers: 8-wheel ball bearing trolley.
  - 4. Flat Lead Post Hangers: Double ball bearing rollers at each side with an 8-wheel ball bearing trolley.
- C. Power source shall be: 120-volt AC input. System operation voltage shall be dual sourced from DC power supply and backup battery.
- D. Automatic Closing System shall be listed to UL864 including capability to send and receive signals from the Fire Control Panel and shall consist of the following:
  - 1. Microprocessor based Electronic Control box with the ability to:
    - a. Monitor dual power sources continually for peak performance including:
      - 1) Detect a missing battery, bad battery, or low battery condition.
      - 2) Detect if the charging circuit is bad.
      - 3) Detect fuse failures.
      - 4) Detect high or low AC conditions.
    - b. Monitor the health of the drive train.

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- c. Monitor inputs including faults associated with door block, exit device, patron hardware, and key switches.
  - d. Run a “watch dog” monitoring circuit which will force a software restart in the event the software hangs, including tracking the number of resets that occur for diagnostic purposes.
  - e. Withstand aberrant voltages up to 120 volts AC on the fire alarm input circuit without damage including the ability to indicate that the alarm circuit has not been wired as a dry contact, “no voltage” circuit when errant voltages are applied to the circuit.
  - f. Communicate with other microprocessors on the system via an internal bus system.
  - g. Indicate faults or supervised information both locally and at a remote location.
- 2. Motor Operator Assembly including a DC gear-motor, drive sprocket, clutch, and position sensors. The motor shall drive the door by means of a chain. Standard motor drive speeds range from 6”-10” per second.
  - a. High speed motor operation up to 18” per second is available for conditions requiring high occupant load egress and limited access control.
  - b. Leading Edge shall be pressure sensitive such that contact with an obstruction shall cause the door to stop, pause for a minimum of 3 seconds, then re-close when in alarm mode.
- 3. Exit Device will be located on each side of the door. (Standard operation when access control is not included).
- 4. An optional key switch by others may be provided for operating the door opened and closed when not in fire mode. Location of the key switch to be provided by the architect.
- E. The header shall be provided as an integrated part of the door assembly and shall include track, threaded rods and mechanical attachment hardware.

## 2.05 RELATED CONSTRUCTION

- A. Track Support Construction: Provide supports attached to structure and mounting surface for track including drilling/placement of anchorage points into pre or post tensioned decks, welding/punching/drilling steel members, and all drywall work; comply with door manufacturer’s instructions and recommendations.
- B. Pocket Construction: Provide rated pocket as specified for storage of accordion door when open; comply with door manufacturer’s instructions and recommendations.
- C. Protection: Protect installed work from damage.

## PART 3 – EXECUTION

### 3.01 EXAMINATION

- A. Verify that adjacent construction is suitable for installation of door.
- B. Verify that electrical utilities have been installed and are accessible.
- C. Verify clear opening dimensions and that door opening is plumb.

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D. Notify Architect of any unacceptable conditions or varying dimensions.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions, shop drawings and NFPA 80.

B. Install fire doors plumb and parallel with the finished floor.

C. Installation shall be performed by factory trained and certified installers with experience installing electrically operated accordion folding fire doors.

3.03 ADJUSTING

A. Adjust door installation to provide uniform clearances and smooth, quiet, non-binding operation.

B. Test that all operations are functional and meet the requirements of local codes.

3.04 CLEANING

A. Clean surfaces using manufacturer's recommended means and methods.

END OF SECTION

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Interior storefront framing.
  - 2. Exterior storefront framing.
  - 3. Exterior storefront framing with structural silicone glazing.
  - 4. Exterior and interior manual-swing entrance doors and door-frame units.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

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.
- 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 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.
- 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 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.

- E. 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.
- F. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. 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.
- B. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Source quality-control reports.
- D. Sample Warranties: For special warranties.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. 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.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer 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. 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: Two 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 aluminum-framed entrances and storefronts.
- B. 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, 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.
- C. Structural Loads:
  - 1. Wind Loads: As indicated on Drawings.
  - 2. Other Design Loads: As indicated on Drawings.
- D. Structural: Test according to ASTM E 330 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. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
  - 1. Entrance Doors:
    - a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
    - b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
- F. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
  - 1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 8 lbf/sq. ft.
- G. Energy Performance: Certify and label energy performance according to NFRC as follows:
  - 1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg Fas determined according to NFRC 100.
  - 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.40 as determined according to NFRC 200.
- H. Thermal Movements:
  - 1. Allow for thermal movements resulting from ambient and surface temperature changes:
    - a. 0°F (-18 C) to 180°F (82 C) maximum change (range) in ambient and surface temperatures.
    - b. 75°F (24 C) test interior ambient air temperature
  - 2. Test performance shows 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 for a minimum 3 cycles.

## 2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
  - 1. Kawneer North America; VG TriFab 451, VG TriFab 451T, 451T with SSG, and 500T wide stile as basis of design or comparable product buy one of the following:
  - 2. EFCO Corporation.
  - 3. TRACO.
  - 4. Tubelite.
  - 5. YKK AP America Inc.
- B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

## 2.3 INTERIOR FRAMING

- A. Interior Framing Members; Basis of Design VG TriFab 451: Manufacturer's extruded-or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  - 1. Construction: Non-thermally broken.



2. Glazing System: Retained mechanically with gaskets on four sides.
  3. Glazing Plane: Center.
  4. Finish: 70% PVDF fluoropolymer-based coating Charcoal finish.
  5. Fabrication Method: Field-fabricated stick system.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Materials:
1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
    - a. Sheet and Plate: ASTM B 209.
    - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
    - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
    - d. Structural Profiles: ASTM B 308/B 308M.
  2. Steel Reinforcement: 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.
    - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
    - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
    - c. Hot-Rolled Sheet and Strip: ASTM A 011/A 1011M.

## 2.4 EXTERIOR FRAMING - MULLIONS

- A. Exterior Framing Members; Basis of Design VG TriFab 451T: 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: Center.
  4. Finish: 70% PVDF fluoropolymer-based coating Charcoal finish.
  5. Fabrication Method: Field-fabricated stick system.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Materials:
1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
    - a. Sheet and Plate: ASTM B 209.
    - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.

- c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
  - d. Structural Profiles: ASTM B 308/B 308M.
- 2. Steel Reinforcement: 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.
  - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
  - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
  - c. Hot-Rolled Sheet and Strip: ASTM A 011/A 1011M.

## 2.5 EXTERIOR FRAMING - SSG

- A. Exterior Framing Members; Basis of Design VG TriFab 451T with SSG: 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.
    - a. Glazing Sealants for structural-sealant-glazed systems as recommended by manufacturer for joint type, and as follows:
      - 1) Structural Sealant:
        - a) ASTM C 1184
        - b) Single-component neutral-curing silicone formulation that is compatible with the system components with which it comes in contact
        - c) Specifically formulated and tested for use as structural sealant and approved by a structural-sealant manufacturer for use in the aluminum-framed systems indicated
        - d) Color: Black
      - 2) Weatherseal sealant:
        - a) ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O
        - b) Single-component neutral-curing formulation that is compatible with the structural sealant and other system components with which it comes in contact
        - c) Recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use
        - d) Color: Matching structural sealant
  - 3. Glazing Plane: Structural Silicone Glazing (SSG)
  - 4. Finish: 70% PVDF fluoropolymer-based coating Charcoal finish.
  - 5. Fabrication Method: Field-fabricated stick system.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  - a. Sheet and Plate: ASTM B 209.
  - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
  - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
  - d. Structural Profiles: ASTM B 308/B 308M.
2. Steel Reinforcement: 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.
  - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
  - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
  - c. Hot-Rolled Sheet and Strip: ASTM A 011/A 1011M.

## 2.6 EXTERIOR ENTRANCE DOOR SYSTEMS

- A. Entrance Doors; Basis of Design Insulpor 500T Wide Stile Door: Manufacturer's standard glazed entrance doors for manual-swing operation.
  1. Door Construction: 2-1/4-inch overall thickness, with minimum 0.125-inch-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: Wide Stile with 10" bottom rail
  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: 70% PVDF fluoropolymer-based coating Charcoal finish.

## 2.7 INTERIOR ENTRANCE DOOR SYSTEMS

- A. Entrance Doors; Basis of Design 500 Wide Stile Door: Manufacturer's standard glazed entrance doors for manual-swing operation.
  1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch-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.
  2. Door Design: Wide Stile with 10" bottom rail
  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: 70% PVDF fluoropolymer-based coating Charcoal finish.

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## 2.8 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
- B. Weather Stripping: Manufacturer's standard replaceable components.
  - 1. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
- C. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

## 2.9 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, extruded EPDM rubber.
- C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

## 2.10 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 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 A 123/A 123M or ASTM A 153/A 153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

## 2.11 FABRICATION

- A. Form or extrude aluminum shapes before finishing.

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- 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.
  - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- C. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
  - 1. At exterior doors, provide compression weather stripping at fixed stops.
  - 2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
- D. 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.
- E. 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.
- F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.12 ALUMINUM FINISHES

- A. 70% PVDF, AAMA 2605, Fluoropolymer Coating, Color Charcoal.

## 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

- A. General:

1. Comply with manufacturer's written instructions.
  2. Do not install damaged components.
  3. Fit joints to produce hairline joints free of burrs and distortion.
  4. Rigidly secure nonmovement joints.
  5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
  6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. 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.
- C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
- F. Install glazing as specified in Section 088000 "Glazing."
- G. Entrance Doors: Install 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.

### 3.3 ERECTION TOLERANCES

- A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:
1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
  2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
  3. Alignment:
    - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
    - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
  4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

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END OF SECTION

SECTION 084123 - FIRE RATED GLASS AND FRAMING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Fire rated glass and framing systems for installation as exterior windows assembly.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

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.
- B. Shop Drawings: For fire rated glass and framing system. Include plans, elevations, sections, full-size details, and attachments to other work.
  - 1. Include details of provisions for assembly expansion and contraction.
  - 2. Include full-size isometric details of each vertical-to-horizontal intersection of fire rated glass and framing system, showing the following:
    - a. Joinery, including concealed welds.
    - b. Anchorage.
    - c. Expansion provisions.
    - d. Glazing.
- 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 lengths of full-size components and showing details of the following:
  - 1. Joinery, including concealed welds.
  - 2. Anchorage.
  - 3. Expansion provisions.
  - 4. Glazing.
- F. Delegated-Design Submittal: For fire rated glass and framing system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.



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1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For fire rated glass and framing system, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Source quality-control reports.
- D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire rated glass and framing system to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. 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.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle under provisions specified by manufacturer. For details on storage and product handling, please contact Technical Glass Products and request information on storage and product handling.
- B. Deliver materials to specified destination in manufacturer or distributor's packaging undamaged.
- C. Store off ground, under cover, protected from weather and construction activities.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of fire rated glass and framing system 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:

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- 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.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design fire rated glass and framing systems.
- B. General Performance: Comply with performance requirements specified, as determined by testing of fire rated glass and framing systems representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
  1. Fire rated glass and framing systems 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.
- C. Structural Loads: As indicated on Drawings
- D. Fire-Rated Window Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by UL, for fire ratings indicated, based on testing according to NFPA 257. Assemblies must be factory-welded or come complete with factory-installed mechanical joints and must not require job site fabrication.
- E. Fire Rating Assembly:
  1. Glass: Capable of providing a fire rating for 60 minutes.
  2. Framing: Capable of providing a fire rating for 60, minutes.
- F. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
  1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

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## 2.2 FIRE RATED GLASS AND FRAMING ASSEMBLY

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Technical Glass Products; Fireframes Aluminum Series or an approved comparable product.
  - 1. Product Description:
    - a. Steel fire-rated glazed window system, dual aluminum cover cap format.
    - b. Face width: 2 inch.
    - c. Finish: Baked-enamel or powder-coat finish, color Charcoal; As selected by Architect from full range of industry colors and color densities.
    - d. Duration – Windows Capable of providing a fire rating for 60 minutes.

## 2.3 FRAMING

- A. Steel Framing System 60 min.
  - 1. Steel Frame: Steel framing members made of two halves,;
    - a. Width: Refer to Drawings.
    - b. Depth: Refer to Drawings.
    - c. Steel Pressure Plates: Formed stainless steel pressure plate with dimensions recommended by manufacturer to securely hold glazing material in place.
    - d. Lengths: Refer to the Drawings.
  - 2. Stainless Steel Standoffs, Moment and Connecting Braces: Manufacturers standard to match fire rated glass thickness.
  - 3. Fasteners: Size and type to suit application as recommend by fire rated framing manufacturer.

## 2.4 GLASS

- A. Glass: Laminated glass with an intumescent interlayer as specified in Section 088813 "Fire-Resistant Glazing."
- B. Glazing Gaskets: As recommended by manufacturer.
- C. Glazing Sealants: As recommended by manufacturer.

## 2.5 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
  - 1. Reinforce members as required to receive fastener threads.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch 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 A 123/A 123M or ASTM A 153/A 153M requirements.

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- C. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

## 2.6 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Factory 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.
  - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.7 ALUMINUM FINISHES

- A. Powder-Coat Finish: Polyester Super Durable powder coating which meets AAMA 2604 for chalking and fading. Apply manufacturer's standard powder coating finish system applied to factory-assembled frames before shipping, complying with manufacturer's recommended instructions for surface preparation including pretreatment, application, and minimum dry film thickness.

## 2.8 SOURCE QUALITY CONTROL

- A. Source Limitations for Glazing Accessories: Obtain framing system, glazing and glazing accessories from one source for each product and installation method indicated.

## 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

- A. General:
  - 1. Comply with manufacturer's written instructions.
  - 2. Do not install damaged components.
  - 3. Fit joints to produce hairline joints free of burrs and distortion.
  - 4. Rigidly secure nonmovement joints.
  - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
  - 6. Firmly pack perimeter of framing system to rough opening with mineral wool fire stop insulation or manufacturers recommended intumescent sealant.
- B. 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.
- C. Install components plumb and true in alignment with established lines and grades.
- D. Install glazing as specified in Section 088813 "Fire-Resistant Glazing."

### 3.3 ERECTION TOLERANCES

- A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:
  - 1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
  - 2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
  - 3. Alignment:
    - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
    - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
  - 4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

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3.4 PROTECTION AND CLEANING

- A. Protect glass from contact with contaminating substances resulting from construction operations. Remove any such substances by method approved by glass manufacturer.
- B. Wash glass on both faces not more than four days prior to date scheduled for inspections intended to establish date of substantial completion. Wash glass by method recommended by glass manufacturer.

END OF SECTION

SECTION 084523 - FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the insulated sandwich panel system and accessories as shown and specified. Work includes providing and installing:
  - 1. Wall assemblies

1.2 SUBMITTALS

- A. Submit manufacturer's product data. Include construction details, material descriptions, profiles and finishes of components.
- B. Submit shop drawings. Include plans, elevations and details.
  - 1. Submit manufacturer's color charts showing the full range of colors available for factory finished aluminum. When requested, submit samples for each exposed finish, in 5" long sections for the same thickness and material indicated for the work.
  - 2. When requested, submit manufacturer's sample panels in same thickness and material indicated for the work: Sandwich panels: 14" x 28"
- D. Submit Installer Certificate, signed by installer, certifying compliance with project qualification requirements.
- E. Submit product reports from a qualified independent testing agency indicating each type and class of panel system complies with the project performance requirements, based on comprehensive testing of current products. Previously completed reports will be acceptable if for current manufacturer and indicative of products used on this project.
  - 1. Reports required (if applicable) are:
    - a. International Building Code Evaluation Report (AC 177)
    - b. Flame Spread and Smoke Developed (UL 723) – Submit UL Card
    - c. Burn Extent (ASTM D 635)
    - d. Color Difference (ASTM D 2244)
    - e. Impact Strength (UL 972)
    - f. Bond Tensile Strength (ASTM C 297 after aging by ASTM D 1037)
    - g. Bond Shear Strength (ASTM D 1002)
    - h. Beam Bending Strength (ASTM E 72)
    - i. Insulation U-Factor (NFRC 100)
    - j. NFRC System U-Factor Certification (NFRC 700)

- k. NFRC Visible Light Transmittance (NFRC 202)
- l. Solar Heat Gain Coefficient (NFRC or Calculations)
- m. Condensation Resistance Factor (AAMA 1503) (Insulated Thermally Broken only)
- n. Air Leakage (ASTM E 283)
- o. Structural Performance (ASTM E 330)
- p. Water Penetration (ASTM E 331)
- q. 1200°F Fire Resistance (SWRI)
- r. ASTM E1886/1996 or TAS 201, 202 and 203 (Optional-Windborne Debris)
- s. Performance for Windows (AAMA/WDMA/CSA-101/I.S.2/A440) (Optional)
- t. Fall Through Resistance (ASTM E 661) (Optional)
- u. Class A Roof Covering Burning Brand (UL 790) (Skylight only)

### 1.3 CLOSEOUT SUBMITTALS

- A. Provide field maintenance manual to include in project maintenance manuals.

### 1.4 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:

- 1. Material and products shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least ten consecutive years and which can show evidence of those materials being satisfactorily used on at least six projects of similar size, scope and location. At least three of the projects shall have been in successful use for ten years or longer.
- 2. Panel system must be listed by an ANSI accredited Evaluation Service, which requires quality control inspections and fire, structural and water infiltration testing of sandwich panel systems by an accredited agency.
- 3. Quality control inspections shall be conducted at least once each year and shall include manufacturing facilities, sandwich panel components and production sandwich panels for conformance with AC177 "Translucent Fiberglass Reinforced Plastic (FRP) Faced Panel Wall, Roof and Skylight Systems" as issued by the ICC-ES.

- B. Installer's Qualifications: Installation shall be by an experienced installer, which has been in the business of installing specified panel systems for at least two consecutive years and can show evidence of satisfactory completion of projects of similar size, scope and type.

### 1.5 PERFORMANCE REQUIREMENTS

- A. The manufacturer shall be responsible for the configuration and fabrication of the complete panel system.
  - 1. When requested, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.



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2. Standard panel system shall have less than 0.01 cfm/ft<sup>2</sup> air leakage by ASTM E 283 at 6.24 PSF (50 mph) and no water penetration by ASTM E 331 at 15 PSF; and structural testing by ASTM E 330.
3. Structural Loads (Wall Assemblies). Provide system capable of handling the following loads:
  - a. Positive Wind Load (PSF): 30 PSF
  - b. Negative Wind Load (PSF): 30 PSF

B. Deflection Limits:

1. Wall Panel Assemblies: Limited to L/120 of clear span for each assembly component.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver panel system, components and materials in manufacturer's standard protective packaging.
- B. Store panels on the long edge; several inches above the ground, blocked and under cover in accordance with manufacturer's storage and handling instructions.

1.7 WARRANTY

- A. Provide manufacturer's and installer's written warranty agreeing to repair or replace panel system work, which fails in materials or workmanship within five years from the date of delivery. Failure of materials or workmanship shall include excessive deflection, deterioration of finish on metal in excess of normal weathering, defects in accessories, insulated translucent sandwich panels and other components of the work.

Alternate Aerogel panel: Material or workmanship warranty is within one year from date of delivery.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. The basis for this specification is for products manufactured by Kalwall Corporation. Other manufacturers may bid this project subject to compliance with the performance requirements of this specification and submission of evidence thereof. Listing other manufacturers' names in this specification does not constitute approval of their products or relieve them of compliance with all the performance requirements contained herein.
- B. Kalwall Corporation, Tel: (800) 258-9777 – Fax: (603) 627-7905 – Email: [info@kalwall.com](mailto:info@kalwall.com)

## 2.2 PANEL COMPONENTS

### A. Face Sheets:

1. Translucent faces: Manufactured from glass fiber reinforced thermoset resins, formulated specifically for architectural use.
  - a. Thermoplastic (e.g. polycarbonate, acrylic) faces are not acceptable.
  - b. Face sheets shall not deform, deflect or drip when subjected to fire or flame.
2. Interior face sheets:
  - a. Flame spread: Underwriters Laboratories (UL) listed, which requires periodic unannounced retesting, with flame spread rating no greater than 20 and smoke developed no greater than 200 when tested in accordance with UL 723.
  - b. Burn extent by ASTM D 635 shall be no greater than 1”.
3. Exterior face sheets:
  - a. Color stability: Full thickness of the exterior face sheet shall not change color more than 3 CIE Units DELTA E by ASTM D 2244 after 5 years outdoor South Florida weathering at 5° facing south, determined by the average of at least three white samples with and without a protective film or coating to ensure long-term color stability. Color stability shall be unaffected by abrasion or scratching.
  - b. Strength: Exterior face sheet shall be uniform in strength, impenetrable by hand held pencil and repel an impact minimum of 70 ft. lbs. without fracture or tear when impacted by a 3-1/4” diameter, 5 lb. free-falling ball per UL 972.
4. Appearance:
  - a. Exterior face sheet: Smooth, 0.070” thick and Crystal in color.
  - b. Interior face sheet: Smooth, 0.045” thick and White in color.
  - c. Face sheets shall not vary more than  $\pm 10\%$  in thickness and be uniform in color.

### B. Grid Core:

1. Thermally Broken Composite I-beam grid core shall be of 6063-T6 or 6005-T5 alloy and temper with provisions for mechanical interlocking of muntin-mullion and perimeter. Width of I-beam shall be no less than 7/16”.
2. Thermally Broken Composite I-beam Thermal break: Minimum 1”, thermoset fiberglass composite. Pour and debridge thermal break is not acceptable.

### C. Laminate Adhesive:

1. Heat and pressure resin type adhesive engineered for structural sandwich panel use, with minimum 25-years field use. Adhesive shall pass testing requirements specified by the International Code Council “Acceptance Criteria for Sandwich Panel Adhesives”.

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2. Minimum tensile strength of 750 PSI when the panel assembly is tested by ASTM C 297 after two exposures to six cycles each of the aging conditions prescribed by ASTM D 1037.
3. Minimum shear strength of the panel adhesive by ASTM D 1002 after exposure to four separate conditions:
  - a. 50% Relative Humidity at 68° F: 540 PSI
  - b. 182° F: 100 PSI
  - c. Accelerated Aging by ASTM D 1037 at room temperature: 800 PSI
  - d. Accelerated Aging by ASTM D 1037 at 182° F: 250 PSI

## 2.3 PANEL CONSTRUCTION

- A. Provide sandwich panels of flat fiberglass reinforced translucent face sheets laminated to a grid core of mechanically interlocking I-beams. The adhesive bonding line shall be straight, cover the entire width of the I-beam and have a neat, sharp edge.
  1. Thickness: 2-3/4 inches
  2. Visible Light Transmittance (VLT): Visible LT (NFRC 202 – Center of Glazing Panel) by NFRC certified laboratory: 26%
  3. Solar heat gain coefficient: 0.31
  4. Panel U-factor by NFRC certified laboratory: 2-3/4" thermally broken grid: 0.23.
  5. Complete insulated panel system for walls shall have NFRC certified U-factor of: 0.19
  6. Grid pattern as viewed: Nominal size: 8" x 20"; pattern: Shoji

### Alternate Aerogel panel:

1. Thickness: 2-3/4 inches
  2. Visible Light Transmittance (VLT): Visible LT (NFRC 202 – Center of Glazing Panel) by NFRC certified laboratory: 20%
  3. Solar heat gain coefficient: 0.27
  4. Panel U-factor by NFRC certified laboratory: 2-3/4" thermally broken grid: 0.05
  5. Complete insulated panel system for walls shall have NFRC certified U-factor of: .12
  6. Grid pattern as viewed: Nominal size: 8" x 20"; pattern: Shoji.
- B. Standard panels shall deflect no more than 1.9" at 30 PSF in 10'-0" span without a supporting frame by ASTM E 72.
- C. Standard panels shall withstand 1200° F fire for minimum one hour without collapse or exterior flaming.
- D. Thermally broken panels with translucent insulation: Minimum Condensation Resistance Factor (CRF) of 80 by AAMA 1503 measured on the bond line. System CRF varies based on application.

## 2.4 BATTENS AND PERIMETER CLOSURE SYSTEM

- A. Closure system:

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- Standard Thermally Broken extruded aluminum 6063-T6 and 6063-T5 alloy and temper clamp-tite screw type closure system. Thermal Barrier shall consist of Pour and debridge structural polyurethane.
- B. Sealing tape: Manufacturer's standard, pre-applied to closure system at the factory under controlled conditions.
  - C. Fasteners: 300 series stainless steel screws for aluminum closures, excluding final fasteners to the building.
  - D. Finish:
    - 1. Manufacturer's factory applied finish, which meets the performance requirements of AAMA 2604. Color to be selected from manufacturer's standards.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Installer shall examine substrates, supporting structure and installation conditions.
- B. Do not proceed with panel installation until unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Metal Protection:
  - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
  - 2. Where aluminum will contact concrete, masonry or pressure treated wood, protect against corrosion by painting contact surfaces with bituminous paint or method recommended by manufacturer.

#### 3.3 INSTALLATION

- A. Install the panel system in accordance with the manufacturer's suggested installation instructions and approved shop drawings.
  - 1. Anchor component parts securely in place by permanent mechanical attachment system.
  - 2. Accommodate thermal and mechanical movements.
  - 3. Set perimeter framing in a full bed of sealant compound, or with joint fillers or gaskets to provide weather-tight construction.
- B. Install joint sealants at perimeter joints and within the panel system in accordance with manufacturer's suggested installation instructions and approved shop drawings.

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### 3.4 CLEANING

- A. Clean the panel system interior and exterior, immediately after installation.
- B. Refer to manufacturer's written recommendations.

END OF SECTION

SECTION 085680 – INTERIOR TRANSACTION WINDOW

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Interior transaction window

1.2 REFERENCE

- A. Underwriters Laboratory UL 752-Standard for Bullet Resisting Equipment & ASTM E119-98-Standard Test Methods for Fire Tests of Building Construction and Materials, NIJ Standard 0108.01-(National Institute of Justice) Standard for Ballistic Resistant Protective Materials, ASTM B 209/B 209M- Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate, ASTM A 666-Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar.

1.3 ACTION SUBMITTALS

- A. Submit for approval prior to fabrication: samples, product data (including preparation, storage and installation methods), cuts & anchor spacing, reinforcement & location , product specifications, shop drawings, test reports (current UL Listing Verification & UL 752 Test Results as provided by Underwriters Laboratories), and printed data in sufficient detail to indicate compliance with the contract documents.
- B. Manufacturer's Instructions for installation and cleaning Transaction Window Assemblies. All required submittals shall be approved prior to installation.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For transaction window assemblies to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Manufacturer shall be a Company that specializes in manufacturing products of the specified type with a minimum of five years experience. Installer shall be a Company that specializes in product type specified and Certified for the installation by the manufacturer.

1.6      DELIVERY, STORAGE & HANDLING

- A.    Handle the materials with care to prevent damage. Store materials inside and under cover, stack flat and off floor. Project conditions (temperature, humidity, and ventilation) shall be within the maximum limit recommendations set by manufacturer. Do not install products that are under conditions outside these limits.

1.7      WARRANTY

- A.    All materials shall be warranted against defects for a period of 1 year for the date of receipt at the project site. Certificates of manufacturer's standard limited warranty shall be provided at project completion.

PART 2 - PRODUCTS

2.1      DESIGN PERFORMANCE

- A.    Through the design, manufacturing techniques and material application the Interior Transaction Window with Package Exchanger: shall be of the "non-ricochet" type. This design is intended to permit the encapture and retention of an attacking projectile lessening the potential of a random injury or lateral penetration. This design shall employ a voice port for sound transmission. Each transaction position shall have a stainless-steel cash tray as shown on the drawings. Components must be manufactured in strict accordance with the specifications, design and details. All vision panels shall be cut to size with all exposed edges polished. Necessary holes shall be pre-drilled and tapped where required. Stainless Steel assembly screws and acrylic spacers shall be provided. Frame and channel shall be provided. Anchor screws shall be provided by the installer.
- B.    No field alterations to the construction of the units fabricated under the acceptable standards shall be allowed unless approved by the manufacturer and the architect. Standard manufacturing tolerances shall be +/- 1/16".
- C.    Materials shall meet or exceed UL 752 requirements.

2.2      ACCEPTABLE MANUFACTURERS

- A.    Basis of Design: Total Security Solutions, Inc, 170 National Park Drive, Fowlerville, MI 48836, 800-513-1468. Attn: Sales Department, [info@tssbulletproof.com](mailto:info@tssbulletproof.com) . Web: [www.tssbulletproof.com](http://www.tssbulletproof.com).
- B.    Products that meet material and performance requirements with specified and validated third party testing, are acceptable. "Equal products" shall be required to be pre-submitted and approved.

2.3      BULLET RESISTANT INTERIOR TRANSACTION WINDOW WITH PACKAGE EXCHANGER

- A.    Basis of Design: TSS Interior Transaction Window with Package Exchanger: The window system consists of custom prefabricated bullet resistant panels with secure air passage as required for voice transmission. Includes frame with a recessed cash tray. All accessories for installation are to be included.
- B.    Glazing Options:
  - 1.    Bullet-Resisting Glazing Material Options:
    - a.    Bullet Resistant Level 3 - 1 1/4" LP 1250 Laminated
- C.    Cash tray: Brushed Stainless Steel Counter Mounted
  - 1.    Cash tray to be 18 ga. stainless steel, # 4 finish 16" x 10" from the outside edge of flanges with a clear opening.
  - 2.    Tray to be integrated into casework counter. See the drawings for the shelf materials and design in which the tray is installed.
- D.    Frame Finish: Aluminum - Black anodized
  - 1.    Aluminum sections to be manufactured in accordance with ASTM B209, Extruded aluminum alloy 6063 T5 Anodized or powder coated finish to match the existing décor and be free of sharp edges or burrs when in place. Glazing Channel: U-Channel specifically designed for securing transparencies tightly in place. Angles and stops are only acceptable for top attachment.
  - 2.    Frame to be black anodized aluminum. The bottom of the glazing to be capped with corresponding material on the frame.

2.4      BULLET RESISTANT ACRYLIC PACKAGE PASSER

- A.    Basis of Design: TSS PE Acrylic Package Passer (interlocking). The PE package passer consists of a rectangular box built from transparent bullet resistant glazing material, with doors on the customer and employee sides. A mechanical interlocking mechanism hinged door control, prevents the opening of both doors simultaneously, allowing small packages to be passed through a barrier without a breach of security.
  - 1.    Base Finish - Provide stainless steel 18 ga. #4 finish.
- B.    Option is available for applications requiring the passage of large to very large packages or equipment.
- C.    Product size shall be: TSS PE Acrylic Package Passer
  - 1.    Size shall be Standard size: OD 14"W x 14" H x 16" D
  - 2.    Security Level shall be: **Bullet Resistant Level 3** - 1 1/4" LP 1250 Laminated



### PART 3 - EXECUTIONS

#### 3.1 PREPERATION

- A. Prior to installing the bullet resistant material, the contractor shall verify that all supports have been installed as required by the contract documents and architectural drawings, and approved shop/CAD drawings, if required. Installer shall notify architect of any unsatisfactory preparation that's the responsibility of another installer.
- B. Clean and prepare all surfaces per manufacturer's recommendations for achieving the best results for the substrate under the project conditions.

#### 3.2 INSTALLATION

- A. Do not begin installation until openings have been verified and surfaces properly prepared in accordance with Drawings. Install in accordance with manufacturer's instructions and UL 752. Set all equipment plumb. All products shall be installed per instructions provided by Total Security Solutions, if warranty is to be issued.
- B. Interior Transaction Window with PE: shall arrive on site as a completed unit. Unit shall be installed in provided opening (wall/door), secured to structure (anchors by others).

#### 3.3 POST APPLICATION

- A. Interior Transaction Window with PE: shall be installed in accordance with manufacturer's printed recommendations, including adhering to anchoring and finishing details.
- B. Inspection and Cleaning: Verify installation is complete and complies with manufacturer's requirements. Clean product and accessories, removing excess sealant, labels and protective covers.
- C. Touch-up, repair or replace damaged products before Substantial Completion.
- D. Product Warranty: Applicable warranty shall be issued to owner upon final release of completed project.

END OF SECTION

## SECTION 087100 - DOOR HARDWARE

### PART 1 - GENERAL

#### 1.01 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.

#### 1.02 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 – 2016 Edition – 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
- 1.03 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.

1.04 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.

#### 1.05 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.

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- 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.

#### 1.06 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.
- E. Existing Openings: Where existing doors, frames and/or hardware are to remain, field verify existing functions, conditions and preparations and coordinate to suit opening conditions and to provide proper door operation.

#### 1.07 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 L Series: 10 years
      - 2) Exit Devices

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- a) Von Duprin: 10 years
- 3) Closers
  - a) LCN 4000 Series: 30 years
- 4) Automatic Operators
  - a) LCN: 2 years
- b. Electrical Warranty
  - 1) Locks
    - a) Schlage: 3 years
  - 2) Exit Devices
    - a) Von Duprin: 3 years

#### 1.08 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

#### 2.01 MANUFACTURERS

- A. 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.
- B. 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.
- C. 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.

#### 2.02 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.

## 2.03 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. McKinney TB 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.

## 2.04 CONTINUOUS HINGES

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. ABH
  - 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.

## 2.05 ELECTRIC POWER TRANSFER

### A. Manufacturers:

1. Scheduled Manufacturer and Product:
  - a. Von Duprin EPT-10
2. Acceptable Manufacturers and Products:
  - a. ABH PT1000
  - b. Precision EPT-12C

### 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.

## 2.06 FLUSH BOLTS

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Burns
  - b. Trimco

### B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

## 2.07 COORDINATORS

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Burns
  - b. Trimco

### B. Requirements:

1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers, surface vertical rod exit device strikes, or other stop mounted hardware. Factory-prepared coordinators for vertical rod devices as specified.

## 2.08 MORTISE LOCKS

### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. Schlage L9000 series
2. Acceptable Manufacturers and Products:
  - a. Accurate 9000/9100 series
  - b. Best 45H series

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2-3/5-inch x 3/5 inch with 180-degree visibility. Provide messages color-coded using ANSI Z535 Safety Red with full text and/or symbols, as scheduled, for easy visibility. When applicable allows for lock status indication on both sides of the door.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches.
7. Provide motor based electrified locksets that comply with the following requirements:
  - a. Universal input voltage – single chassis accepts 12 or 24VDC to allow for changes in the field without changing lock chassis.
  - b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case.
  - c. Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.
  - d. Low holding current – maximum 0.01 amps to produce minimal heat, eliminate “hot levers” in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.
  - e. Connections – provide quick-connect Molex system standard.
8. (KEY OVERRIDE OPTION WHEN XL13-439 IS SPECIFIED IN HARDWARE SETS) Provide locks with a key override feature built into the chassis that allows the outside key to retract the deadbolt and/or latchbolt, overriding the inside thumbturn when it is being held in the locked position.
9. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
  - a. Vandlgard: Provide levers with vandal resistant technology for use at heavy traffic or abusive applications.
  - b. Lever Design: 17A

2.09 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. Best 9K Series
2. Acceptable Manufacturers and Products:
  - a. Schlage ND Series
  - b. Corbin-Russwin CL3100 series

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: 14

2.10 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. Von Duprin 99/33A series
2. Acceptable Manufacturers and Products:
  - a. Detex Advantex series
  - b. Precision APEX 2000 series

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 grooved 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 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. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
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.

## 2.11 CYLINDERS

### A. Manufacturers:

1. Scheduled Manufacturer and Product:
  - a. Best Small Format Interchangeable Core
2. Acceptable Manufacturers and Products:

### 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. New factory registered system:
  - a. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

### B. Requirements:

1. Construction Keying:
  - a. Temporary Construction Cylinder Keying.

- 1) Provide construction cores that permit voiding construction keys without cylinder removal, furnished in accordance with the following requirements.
      - a) Split Key or Lost Ball Construction Keying System.
      - b) 3 construction control keys, and extractor tools or keys as required to void construction keying.
      - c) 12 construction change (day) keys.
    - 2) Owner or Owner's Representative will void operation of temporary construction keys.
  - b. 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).
    - 3) Geographically Exclusive: Where High Security or Security cylinders/cores are indicated, provide nationwide, geographically exclusive key system complying with the following restrictions.
  - 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 CONTROL SYSTEM

### A. Manufacturers:

#### 1. Scheduled Manufacturer:

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- 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.

## 2.14 DOOR CLOSERS

- A. Manufacturers and Products:
  - 1. Scheduled Manufacturer and Product:
    - a. LCN 4010/4110/4020 series
  - 2. Acceptable Manufacturers and Products:
    - a. Corbin-Russwin DC8000 series
    - b. Sargent 281 series
- 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.

#### 2.15 DOOR CLOSERS

#### 2.16 ELECTRO-HYDRAULIC AUTOMATIC OPERATORS

##### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. LCN 4600 series
2. Acceptable Manufacturers and Products:
  - a. Norton 6000 series
  - b. Precision D4990 series

##### B. Requirements:

1. Provide low energy automatic operator units with hydraulic closer complying with ANSI/BHMA A156.19.
2. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
3. Provide units with conventional door closer opening and closing forces unless power operator motor is activated. Provide door closer assembly with adjustable spring size, back-check, and opening and closing speed adjustment valves to control door
4. Provide units with on/off switch for manual operation, motor start up delay, vestibule interface delay, electric lock delay, and door hold open delay.
5. Provide drop plates, brackets, and adapters for arms as required for details.
6. Provide actuator switches and receivers for operation as specified.
7. Provide weather-resistant actuators at exterior applications.
8. Provide key switches with LED's, recommended and approved by manufacturer of automatic operator as required for function described in operation description of hardware group below. Cylinders: Refer to "KEYING" article, herein.
9. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf. Actuators control both doors simultaneously at pairs. Sequence operation of exterior and vestibule doors with automatic operators to allow ingress or egress through both sets of openings as directed by Architect. Locate actuators, key switches, and other controls as directed by Architect.
10. Provide units with vestibule inputs that allow sequencing operation of two units, and SPDT relay for interfacing with latching or locking devices.

#### 2.17 DOOR TRIM

##### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:

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- 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.

2.18 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. Size 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.

2.19 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

- 1. Scheduled Manufacturers:
  - a. Glynn-Johnson
- 2. Acceptable Manufacturers:
  - a. Rixson
  - b. ABH

B. Requirements:

- 1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.20 DOOR STOPS AND HOLDERS

A. Manufacturers:

- 1. Scheduled Manufacturer:

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- 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.

## 2.21 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

- A. Manufacturers:
  - 1. Scheduled Manufacturer:
    - a. Zero International
  - 2. Acceptable Manufacturers:
    - a. National Guard
    - b. Reese
- B. Requirements:
  - 1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
  - 2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
  - 3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
  - 4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

## 2.22 SILENCERS

- A. Manufacturers:
  - 1. Scheduled Manufacturer:
    - a. Ives
  - 2. Acceptable Manufacturers:
    - a. Burns
    - b. Trimco
- B. Requirements:

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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.

## 2.23 MAGNETIC HOLDERS

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. LCN
2. Acceptable Manufacturers:
  - a. Rixson
  - b. Sargent

### B. Requirements:

1. Provide wall or floor mounted electromagnetic door release as specified with minimum of 25 pounds of holding force. Coordinate projection of holder and armature with other hardware and wall conditions to ensure that door sits parallel to wall when fully open. Connect magnetic holders on fire-rated doors into the fire control panel for fail-safe operation.

## 2.24 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

## PART 3 - EXECUTION

### 3.01 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.

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- 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.

### 3.02 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.

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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: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- 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: Apply to head and jamb, forming seal between door and frame.
- 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.

### 3.03 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.

### 3.04 CLEANING AND PROTECTION

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- 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.

3.05 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:

Abbreviation	Name
BES	Best Locking Systems
GLY	Glynn-Johnson Corp
IVE	H.B. Ives
LCN	LCN Commercial Division
SCH	Schlage Lock Company
VON	Von Duprin
ZER	Zero International Inc

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## Legend:




 Link to catalog cut sheet Electrified Opening

## Hardware Group No. 01

For use on Door #(s):

116A 118

Provide each SGL door(s) with the following:




QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PASSAGE LOCK	9K-X-7-N-14-C-X		626	
1	EA	WALL STOP	WS406/407CCV		626	IVE
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

## Hardware Group No. 01A

For use on Door #(s):

151A

Provide each SGL door(s) with the following:









QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PASSAGE LOCK	9K-X-7-N-14-C-X		626	
1	EA	WALL STOP/HOLDER	WS40		626	IVE
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

## Hardware Group No. 02

For use on Door #(s):

S4-R

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	224HD		628	IVE
1	EA	INSTITUTIONAL LOCK	9K-X-7-W-X		626	BES
2	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	SURFACE CLOSER	4111 SCUSH MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		626	IVE
1	EA	RAIN DRIP	142A DW + 4"		AA	ZER
1	EA	GASKETING	488FSBK PSA		BK	ZER
1	EA	DOOR SWEEP	8198AA		AA	ZER
1	EA	THRESHOLD	545A		A	ZER



TREDYFFRIN EASTTOWN SCHOOL DISTRICT  
NEW ELEMENTARY SCHOOL

DOOR HARDWARE

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Hardware Group No. 03

For use on Door #(s):

S1-1A	S1-2A	S1-3A	S2-1C	S2-2A	S2-2B
S2-3A	S3-1A	S3-2A	S3-3A		

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	224HD		628	IVE
1	EA	FIRE EXIT HARDWARE	9947-EO-F-LBRAFL		626	VON
1	EA	FIRE EXIT HARDWARE	9947-L-BE-F-LBR-17		626	VON
2	EA	SURFACE CLOSER	4111 EDA MC		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
2	EA	FIRE/LIFE WALL MAG	SEM7800 AS REQUIRED	 	689	LCN
1	EA	GASKETING	488FSBK PSA		BK	ZER
1	SET	MEETING STILE	8879AA-S		AA	ZER

DOORS NORMALLY HELD OPEN BY WALL MAGNET.

UPON LOSS OF POWER OR FIRE ALARM, WALL MAGNET WILL RELEASE AND DOORS WILL CLOSE AND LATCH.








FREE EGRESS AT ALL TIMES.

Hardware Group No. 04

For use on Door #(s):

109	129	130	131	141	207
208	209	210	216	217	235
236	237	238	306	307	309
310	316	317	334A		

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK W OUTSIDE INDICATOR	45H-7-L-14-H-VIN		626	BES
1	EA	SURFACE CLOSER	4111 EDA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		626	IVE
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

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Hardware Group No. 04B

For use on Door #(s):

116B	119A	119B	122A	122B	123A
123B	125A	125B	128A	128B	132A
140A	201A	201B	203B		

Provide each SGL door(s) with the following:









QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR X THUMBTURN BOTH SIDES	L9040 17A 09-544 OS-SYM XL11- 446		626	SCH
1	EA	SURFACE CLOSER	4111 EDA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		626	IVE
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

Hardware Group No. 04C

For use on Door #(s):

110A	110B	111A	111B	229	230
329	330				

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	DOUBLE CYLINDER DEADBOLT W INDICATOR	45H-7-F16-X-VIN			BES
1	EA	PUSH PLATE	8200 6" X 16"		630	IVE
1	EA	PULL PLATE	8305 10" 6" X 16"		630	IVE
1	EA	SURFACE CLOSER	4111 EDA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		626	IVE
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

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Hardware Group No. 05

For use on Door #(s):

100A                      115A                      115B                      117                      137

Provide each SGL door(s) with the following:







QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRANCE/OFFICE LOCK	9K-X-7-UA-X		626	BES
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	WALL STOP	WS406/407CCV		626	IVE
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

Hardware Group No. 05A

For use on Door #(s):

102	116	116C	133	203A	204A
206A	214	223	225	226	239
301	302	314	318	323	324
325	326				

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRY/OFFICE MORTISE LOCK W/ INDICATOR	45H-7IND14M STD		626	BES
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	SURFACE CLOSER	4111 EDA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		626	IVE
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

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Hardware Group No. 05B

For use on Door #(s):

119	121	122	123	125	128
132	139	140	142	146	147
148	200	202	203	212	213
215	220	221	222	303	304
308	311	312	313	315	320
321	322				

Provide each SGL door(s) with the following:







QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	ENTRY/OFFICE MORTISE LOCK W/ INDICATOR	45H-7IND14M STD		626	BES
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	SURFACE CLOSER	4111 EDA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		626	IVE
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

Hardware Group No. 05C

For use on Door #(s):

124	205	211
-----	-----	-----

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRY/OFFICE MORTISE LOCK W/ INDICATOR	45H-7IND14M STD		626	BES
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	SURFACE CLOSER	4111 SCUSH MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		626	IVE
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

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Hardware Group No. 05D

For use on Door #(s):

122C                      123C                      125C                      128C                      134                      204B  
224

Provide each SGL door(s) with the following:






QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRY/OFFICE MORTISE LOCK W/ INDICATOR	45H-7IND14M STD		626	BES
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	OH STOP	100S		652	GLY
1	EA	SURFACE CLOSER	4111 EDA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

Hardware Group No. 05E

For use on Door #(s):

335B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRANCE/OFFICE LOCK	9K-X-7-UA-X		626	BES
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	SURFACE CLOSER	4111 SCUSH MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

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Hardware Group No. 05F

For use on Door #(s):

233

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	CONST LATCHING BOLT	FB51T		630	IVE
1	EA	ENTRY/OFFICE MORTISE LOCK W/ INDICATOR	45H-7IND14M STD		626	BES
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	SURFACE CLOSER	4111 SCUSH MC		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		626	IVE
1	EA	GASKETING	488FSBK PSA		BK	ZER
1	SET	MEETING STILE	8879AA-S		AA	ZER

Hardware Group No. 07B

For use on Door #(s):







150C

150D

150E

150F

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM LOCK	9K-X-7-R-14-C-X		626	BES
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	SURFACE CLOSER	4111 EDA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP/HOLDER	WS40		626	IVE
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

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Hardware Group No. 07C

For use on Door #(s):

107

Provide each SGL door(s) with the following:







QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM LOCK	9K-X-7-R-14-C-X		626	BES
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	OH STOP & HOLDER	100H		652	GLY
1	EA	SURFACE CLOSER	4011 MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

Hardware Group No. 07D

For use on Door #(s):

332

Provide each SGL door(s) with the following:







QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM LOCK	9K-X-7-R-14-C-X		626	BES
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	OH STOP	100S		652	GLY
1	EA	SURFACE CLOSER	4111 EDA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

Hardware Group No. 07E

For use on Door #(s):

333

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM LOCK	9K-X-7-R-14-C-X		626	BES
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	SURFACE CLOSER	4111 EDA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		626	IVE
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

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Hardware Group No. 07F

For use on Door #(s):

114A 114B

Provide each SGL door(s) with the following:





QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	112HD		SPBLK	IVE
1	EA	CLASSROOM LOCK	9K-X-7-R-14-C-X		622	BES
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		622	
1	EA	SURFACE CLOSER	4111 EDA MC		693	LCN
1	EA	WALL STOP	WS406/407CCV		BLK	IVE
1	EA	PERIMETER GASKET	BY DOOR MFR			

Hardware Group No. 08

For use on Door #(s):

108 112 119C1 119C2 135 138  
149C 205A 205B 228 232 327  
328

Provide each SGL door(s) with the following:







QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	9K-X-7-D-14-C-X		626	BES
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	WALL STOP	WS406/407CCV		626	IVE
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

Hardware Group No. 08A

For use on Door #(s):

103B 127 127A 206B 219 227  
231 319 331

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	9K-X-7-D-14-C-X		626	BES
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	SURFACE CLOSER	4111 EDA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		626	IVE
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE



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Hardware Group No. 08B

For use on Door #(s):

126 150A

Provide each SGL door(s) with the following:





QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	9K-X-7-D-14-C-X		626	BES
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	SURFACE CLOSER	4111 SCUSH MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		626	IVE
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

Hardware Group No. 08C

For use on Door #(s):

305

Provide each SGL door(s) with the following:









QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	9K-X-7-D-14-C-X		626	BES
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	OH STOP	90S		652	GLY
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

Hardware Group No. 08D

For use on Door #(s):

101 104

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	CONST LATCHING BOLT	FB51P		630	IVE
1	EA	DUST PROOF STRIKE	DP2		626	IVE
1	EA	STOREROOM LOCK	9K-X-7-D-14-C-X		626	BES
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
2	EA	OH STOP	90S		652	GLY
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	SET	MEETING STILE	8879AA-S		AA	ZER
2	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

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Hardware Group No. 08E

For use on Door #(s):

100B

Provide each PR door(s) with the following:









QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CONST LATCHING BOLT	FB51P		630	IVE
1	EA	DUST PROOF STRIKE	DP2		626	IVE
1	EA	STOREROOM LOCK	9K-X-7-D-14-C-X		626	BES
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	OH STOP	90S		652	GLY
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		626	IVE
1	SET	MEETING STILE	8879AA-S		AA	ZER
2	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

Hardware Group No. 08F

For use on Door #(s):

234A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CONST LATCHING BOLT	FB51P		630	IVE
1	EA	DUST PROOF STRIKE	DP2		626	IVE
1	EA	STOREROOM LOCK	9K-X-7-D-14-C-X		626	BES
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
2	EA	OH STOP	90S		652	GLY
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	SET	MEETING STILE	8879AA-S		AA	ZER
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

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Hardware Group No. 08G

For use on Door #(s):

143 144 218

Provide each SGL door(s) with the following:









QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	9K-X-7-D-14-C-X		626	BES
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	OH STOP	90S		652	GLY
1	EA	SURFACE CLOSER	4111 EDA MC		689	LCN
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE

Hardware Group No. 08H

For use on Door #(s):

300A 300B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	CONST LATCHING BOLT	FB52		630	IVE
1	EA	STOREROOM LOCK	9K-X-7-D-14-C-X		626	BES
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	COORDINATOR	COR X FL		628	IVE
2	EA	SURFACE CLOSER	4111 SCUSH MC		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	EA	GASKETING	488FSBK PSA		BK	ZER
1	SET	MEETING STILE	8879AA-S		AA	ZER

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Hardware Group No. 09

For use on Door #(s):

335A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	224HD EPT		628	IVE
1	EA	POWER TRANSFER	EPT10		⚡ 689	VON
1	EA	ELECTRONIC LOCK (FAIL SECURE)	9K-X-7-DEU-X		⚡ 626	BES
1	EA	OH STOP	90S		652	GLY
1	EA	SURFACE CLOSER	4111 EDA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE
1	EA	CREDENTIAL READER	BY DIV 28	⚡		
1	EA	DOOR CONTACT	BY DIV 28	⚡		
1		POWER SUPPLY	BY DIV 28			

DOOR OPERATION:

DOOR NORMALLY CLOSED AND LOCKED.

ENTRY BY KEY OR VALID CREDENTIAL.

FREE EGRESS AT ALL TIMES.

UPON LOSS OF POWER, DOOR REMAINS LOCKED. [FAIL SECURE]

RX MONITORS EXIT DEVICE PUSH PAD.

DC MONITORS DOOR POSITION.

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Hardware Group No. 09A

For use on Door #(s):

148A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	224HD		711	IVE
1	EA	DOOR CORD	788C-18 WITH 20 GAUGE WIRES		⚡ 626	SCE
1	EA	STOREROOM LOCK	9K-X-7-D-14-C-X		622	BES
1	EA	ELECTRIC STRIKE	6400 FSE 12/24 VAC/VDC		⚡ 630	VON
1	EA	LOCK GUARD	LG13		USP	IVE
1	EA	SURFACE CLOSER	4111 SCUSH MC		689	LCN
1	EA	GASKETING	488FSBK PSA		BK	ZER
1	EA	DOOR SWEEP	8198AA		AA	ZER
1	EA	THRESHOLD	545A		A	ZER
1	EA	CREDENTIAL READER	BY DIV 28		⚡	
1	EA	DOOR CONTACT	BY DIV 28		⚡	
1		POWER SUPPLY	BY DIV 28			

DOOR OPERATION:

DOOR NORMALLY CLOSED AND LOCKED.

ENTRY BY KEY OR VALID CREDENTIAL.

FREE EGRESS AT ALL TIMES.

UPON LOSS OF POWER, DOOR REMAINS LOCKED. [FAIL SECURE]

DC MONITORS DOOR POSITION.

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Hardware Group No. 10

For use on Door #(s):

334B 334C

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	224HD EPT		628	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-L-NL-17-CON 24 VDC		⚡ 626	VON
1	EA	SFIC RIM CYLINDER	80-159 ICX		626	SCH
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	SURFACE CLOSER	4111 EDA MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		626	IVE
3	EA	SILENCER	SR 64/65 AS REQUIRED		GRY	IVE
1	EA	WIRE HARNESS	CON-XXP			SCH
1	EA	WIRE HARNESS	CON-6W			SCH
1	EA	CREDENTIAL READER	BY DIV 28		⚡	
1	EA	DOOR CONTACT	BY DIV 28		⚡	
1		POWER SUPPLY	BY DIV 28			

DOOR OPERATION:

DOOR NORMALLY CLOSED AND LOCKED.

ENTRY BY KEY OR VALID CREDENTIAL.

FREE EGRESS AT ALL TIMES.

UPON LOSS OF POWER, DOOR REMAINS LOCKED. [FAIL SECURE]

RX MONITORS EXIT DEVICE PUSH PAD.

DC MONITORS DOOR POSITION.

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Hardware Group No. 10A

For use on Door #(s):

123DA

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	224HD EPT		628	IVE
1	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-L-NL-17-CON 24 VDC		⚡ 626	VON
1	EA	SFIC RIM CYLINDER	80-159 ICX		626	SCH
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	SURFACE CLOSER	4111 SCUSH MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142A DW + 4"		AA	ZER
1	EA	GASKETING	488FSBK PSA		BK	ZER
1	EA	DOOR SWEEP	8198AA		AA	ZER
1	EA	THRESHOLD	545A		A	ZER
1	EA	WIRE HARNESS	CON-XXP			SCH
1	EA	WIRE HARNESS	CON-6W			SCH
1	EA	CREDENTIAL READER	BY DIV 28		⚡	
1	EA	DOOR CONTACT	BY DIV 28		⚡	
1		POWER SUPPLY	BY DIV 28			

DOOR OPERATION:

DOOR NORMALLY CLOSED AND LOCKED.

ENTRY BY KEY OR VALID CREDENTIAL.

FREE EGRESS AT ALL TIMES.

UPON LOSS OF POWER, DOOR REMAINS LOCKED. [FAIL SECURE]

RX MONITORS EXIT DEVICE PUSH PAD.

DC MONITORS DOOR POSITION.

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Hardware Group No. 10B

For use on Door #(s):

100C                      100D                      103A                      150B                      S3-1B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	224HD EPT		628	IVE
2	EA	POWER TRANSFER	EPT10 CON	 ⚡	689	VON
1	EA	ELEC PANIC HARDWARE	LD-RX-9947-EO	 ⚡	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-9947-L-NL-17-CON 24 VDC	 ⚡	626	VON
1	EA	SFIC RIM CYLINDER	80-159 ICX		626	SCH
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
2	EA	SURFACE CLOSER	4111 SCUSH MC		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142A DW + 4"		AA	ZER
1	EA	GASKETING	488FSBK PSA		BK	ZER
2	EA	DOOR SWEEP	8198AA		AA	ZER
1	EA	THRESHOLD	545A		A	ZER
2	EA	WIRE HARNESS	CON-XXP			SCH
2	EA	WIRE HARNESS	CON-6W			SCH
1	EA	CREDENTIAL READER	BY DIV 28	⚡		
2	EA	DOOR CONTACT	BY DIV 28	⚡		
1		POWER SUPPLY	BY DIV 28			

DOOR OPERATION:

DOOR NORMALLY CLOSED AND LOCKED.

ENTRY BY KEY OR VALID CREDENTIAL.

FREE EGRESS AT ALL TIMES.

UPON LOSS OF POWER, DOOR REMAINS LOCKED. [FAIL SECURE]

RX MONITORS EXIT DEVICE PUSH PAD.

DC MONITORS DOOR POSITION.



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Hardware Group No. 10C

For use on Door #(s):

106C

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112HD EPT		SPBLK	IVE
2	EA	POWER TRANSFER	EPT10 CON		⚡ 622	VON
1	EA	ELEC PANIC HARDWARE	LD-RX-9947-EO-LBR		⚡ 711	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-9947-NL-OP-LBR-110MD-CON 24 VDC		⚡ US19/7 11	VON
1	EA	SFIC RIM CYLINDER X CONST. CORE	80-159 ICX		622	SCH
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		622	
1	EA	DOOR PULL	VR910 DT		630	IVE
1	EA	DOOR PULL	VR910 NL		630	IVE
2	EA	SURFACE CLOSER	4111 SCUSH MC		693	LCN
1	EA	PERIMETER GASKET	BY DOOR MFR			
2	EA	WIRE HARNESS	CON-XXP			SCH
2	EA	WIRE HARNESS	CON-6W			SCH
1	EA	CREDENTIAL READER	BY DIV 28	⚡		
2	EA	DOOR CONTACT	BY DIV 28	⚡		
1		POWER SUPPLY	BY DIV 28			

DOOR OPERATION:

DOOR NORMALLY CLOSED AND LOCKED.

ENTRY BY KEY OR VALID CREDENTIAL.

FREE EGRESS AT ALL TIMES.

UPON LOSS OF POWER, DOOR REMAINS LOCKED. [FAIL SECURE]

RX MONITORS EXIT DEVICE PUSH PAD.

DC MONITORS DOOR POSITION.

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Hardware Group No. 11

For use on Door #(s):

106D

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112HD		SPBLK	IVE
1	EA	PANIC HARDWARE	CDSI-9947-EO-LBR		711	VON
1	EA	PANIC HARDWARE	CDSI-9947-NL-OP-LBR-110MD		US19/7 11	VON
2	EA	SFIC MORTISE CYL.	80-132 ICX		622	SCH
1	EA	SFIC RIM CYLINDER X CONST. CORE	80-159 ICX		622	SCH
3	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		622	
1	EA	DOOR PULL	VR910 DT		630	IVE
1	EA	DOOR PULL	VR910 NL		630	IVE
2	EA	SURFACE CLOSER	4111 SCUSH MC		693	LCN
1	EA	PERIMETER GASKET	BY DOOR MFR			
2	EA	DOOR CONTACT	BY DIV 28			

DOOR OPERATION:

DOOR NORMALLY CLOSED AND LOCKED.

ENTRY BY KEY OR VALID CREDENTIAL.

FREE EGRESS AT ALL TIMES.

UPON LOSS OF POWER, DOOR REMAINS LOCKED. [FAIL SECURE]

RX MONITORS EXIT DEVICE PUSH PAD.

DC MONITORS DOOR POSITION.







Hardware Group No. 11A

For use on Door #(s):

145

S4-3A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	224HD		628	IVE
1	EA	FIRE EXIT HARDWARE	99-L-NL-F-17		626	VON
1	EA	SFIC RIM CYLINDER	80-159 ICX		626	SCH
1	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
1	EA	SURFACE CLOSER	4111 SCUSH MC		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	488FSBK PSA		BK	ZER

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Hardware Group No. 12

For use on Door #(s):

105A                      105B                      149A                      149B                      206C                      234B  
234C

Provide each PR door(s) with the following:








QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	224HD		628	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB		689	VON
1	EA	PANIC HARDWARE	CDSI-99-EO		626	VON
1	EA	PANIC HARDWARE	CDSI-99-L-NL-17		626	VON
1	EA	MULLION STORAGE KIT	MT54		689	VON
3	EA	SFIC MORTISE CYL.	80-132 ICX		626	SCH
1	EA	SFIC RIM CYLINDER	80-159 ICX		626	SCH
4	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		626	BES
2	EA	SURFACE CLOSER	4111 SCUSH MC		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	EA	GASKETING	488FSBK PSA		BK	ZER
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
1	EA	THRESHOLD	SCHEDULED TRANSITION BY FLOORING			

Hardware Group No. 12A

For use on Door #(s):

206

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112HD		SPBLK	IVE
1	EA	PANIC HARDWARE	CDSI-9947-EO-LBR		711	VON
1	EA	PANIC HARDWARE	CDSI-9947-L-NL-LBR-17		711	VON
1	EA	MULLION STORAGE KIT	MT54		SPBLK	VON
2	EA	SFIC MORTISE CYL.	80-132 ICX		622	SCH
1	EA	SFIC RIM CYLINDER X CONST. CORE	80-159 ICX		622	SCH
3	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		622	
2	EA	SURFACE CLOSER	4111 SCUSH MC		693	LCN
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
1	EA	PERIMETER GASKET	BY DOOR MFR			
1	EA	THRESHOLD	SCHEDULED TRANSITION BY FLOORING			

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Hardware Group No. 13

For use on Door #(s):

113A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112HD EPT		SPBLK	IVE
2	EA	POWER TRANSFER	EPT10 CON		⚡ 622	VON
2	EA	ELEC PANIC HARDWARE	SD-RX-QEL-99-EO-CON 24 VDC		⚡ 711	VON
2	EA	SFIC MORTISE CYL.	80-132 ICX		622	SCH
3	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		622	
2	EA	DOOR PULL	VR910 DT		630	IVE
1	EA	OH STOP	100S		BLK	GLY
1	EA	SURFACE CLOSER	4111 SCUSH MC		693	LCN
1	EA	SURF. AUTO OPERATOR	4631 120 VAC		⚡ 693	LCN
2	EA	ACTUATOR, TOUCHLESS	8310-810D		⚡ 630	LCN
2	EA	MOUNT BOX	8310-867F			LCN
2	EA	WIRE HARNESS	CON-XXP			SCH
2	EA	WIRE HARNESS	CON-6W			SCH
1	EA	CREDENTIAL READER	BY DIV 28		⚡	
2	EA	DOOR CONTACT	BY DIV 28		⚡	
1		POWER SUPPLY	BY DIV 28			

DOOR OPERATION:

DOORS NORMALLY CLOSED AND LOCKED.

ENTRY BY MECHANICAL KEY OR VALID CREDENTIAL.

FREE EGRESS AT ALL TIMES.

PRESENTING A VALID CREDENTIAL WILL RETRACT LATCHES AND ENABLE EXTERIOR ACTUATOR.

INSIDE ACTUATOR ALWAYS ACTIVE.

UPON LOSS OF POWER, DOORS REMAIN LOCKED [FAIL SECURE].

RX MONITORS EXIT DEVICE PUSH PAD.

DOOR CONTACT MONITORS DOOR POSITION.

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Hardware Group No. 14

For use on Door #(s):

106A 106B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112HD EPT		SPBLK	IVE
2	EA	POWER TRANSFER	EPT10 CON		⚡ 622	VON
1	EA	ELEC PANIC HARDWARE	CDSI-RX-9947-NL-OP-110MD-CON		⚡ US19/711	VON
1	EA	ELEC PANIC HARDWARE	SD-RX-QEL-9947-EO-CON 24 VDC		⚡ 711	VON
2	EA	SFIC MORTISE CYL.	80-132 ICX		622	SCH
1	EA	SFIC RIM CYLINDER X CONST. CORE	80-159 ICX		622	SCH
3	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		622	
1	EA	DOOR PULL	VR910 DT		630	IVE
1	EA	DOOR PULL	VR910 NL		630	IVE
1	EA	OH STOP	100S		BLK	GLY
1	EA	SURFACE CLOSER	4111 SCUSH MC		693	LCN
1	EA	SURF. AUTO OPERATOR	4642 120 VAC		⚡ 693	LCN
2	EA	ACTUATOR, TOUCHLESS	8310-810D		⚡ 630	LCN
2	EA	MOUNT BOX	8310-867F			LCN
1	EA	PERIMETER GASKET	BY DOOR MFR			
2	EA	WIRE HARNESS	CON-XXP			SCH
2	EA	WIRE HARNESS	CON-6W			SCH
1	EA	CREDENTIAL READER	BY DIV 28		⚡	
2	EA	DOOR CONTACT	BY DIV 28		⚡	
1		POWER SUPPLY	BY DIV 28			

DOOR OPERATION:

DOORS NORMALLY CLOSED AND LOCKED.

ENTRY BY MECHANICAL KEY OR VALID CREDENTIAL.

FREE EGRESS AT ALL TIMES.

PRESENTING A VALID CREDENTIAL WILL RETRACT LATCHES AND ENABLE EXTERIOR ACTUATOR.

INSIDE ACTUATOR ALWAYS ACTIVE.

UPON LOSS OF POWER, DOORS REMAIN LOCKED [FAIL SECURE].

RX MONITORS EXIT DEVICE PUSH PAD.

DOOR CONTACT MONITORS DOOR POSITION.

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Hardware Group No. 14A

For use on Door #(s):

136

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	112HD EPT		SPBLK	IVE
2	EA	POWER TRANSFER	EPT10 CON		✓ 622	VON
1	EA	ELEC PANIC HARDWARE	CDSI-RX-9947-NL-OP-110MD-CON		✓ US19/7 11	VON
1	EA	ELEC PANIC HARDWARE	SD-RX-QEL-9947-EO-CON 24 VDC		✓ 711	VON
2	EA	SFIC MORTISE CYL.	80-132 ICX		622	SCH
1	EA	SFIC RIM CYLINDER X CONST. CORE	80-159 ICX		622	SCH
3	EA	CYLINDER CORE	SFIC BEST - PER OWNER STANDARD		622	
1	EA	DOOR PULL	VR910 DT		630	IVE
1	EA	DOOR PULL	VR910 NL		630	IVE
2	EA	SURFACE CLOSER	4111 SCUSH MC		693	LCN
1	EA	PERIMETER GASKET	BY DOOR MFR			
2	EA	WIRE HARNESS	CON-XXP			SCH
2	EA	WIRE HARNESS	CON-6W			SCH
1	EA	CREDENTIAL READER	BY DIV 28	✓		
1	EA	INTERCOM	BY DIV 28	✓		
2	EA	DOOR CONTACT	BY DIV 28	✓		
1		POWER SUPPLY	BY DIV 28			

DOOR OPERATION:

DOORS NORMALLY CLOSED AND LOCKED.

ENTRY BY MECHANICAL KEY, VALID CREDENTIAL OR INTERCOM.

FREE EGRESS AT ALL TIMES.

UPON LOSS OF POWER, DOORS REMAIN LOCKED [FAIL SECURE].

RX MONITORS EXIT DEVICE PUSH PAD.

DOOR CONTACT MONITORS DOOR POSITION.

WHEN DOGGED, DOORS WILL BE PUSH/PULL WITH FREE EGRESS IN BOTH DIRECTIONS.

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Hardware Group No. 15

For use on Door #(s):

300C

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	EA	CONT. HINGE	224HD EPT		628	IVE
2	EA	POWER TRANSFER	EPT10 CON		⚡ 689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB		689	VON
1	EA	DELAYED PANIC HARDWARE	CX98-EO-CON 24 VDC		⚡ 630	VON
1	EA	DELAYED PANIC HARDWARE	CX98-L-BE-17-CON 24 VDC		⚡ 630	VON
1	EA	MULLION STORAGE KIT	MT54		689	VON
2	EA	SURFACE CLOSER	4111 SCUSH MC		689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS		630	IVE
1	EA	GASKETING	488FSBK PSA		BK	ZER
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	WIRE HARNESS	CON-XXP			SCH
2	EA	WIRE HARNESS	CON-6W			SCH
1	EA	CREDENTIAL READER	BY DIV 28		⚡	
2	EA	DOOR CONTACT	BY DIV 28		⚡	
1		POWER SUPPLY	BY DIV 28			

DOOR NORMALLY CLOSED AND LATCHED.

UPON PRESSING PUSHBAR, ALARM WILL SOUND. AFTER 15 SECONDS, EGRESS WILL BE GRANTED.

ALARM RESET BY VALID CREDENTIAL OR ACCESS CONTROL SYSTEM.

UPON POWER FAILURE OR FIRE ALARM, DELAYED EGRESS IS SHUNTED AND IMMEDIATE EGRESS IS GRANTED.

DPS MONITORS DOOR POSITION.

Hardware Group No. SL

For use on Door #(s):

S2-1A

S2-1B

Provide each SL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	WON-DOOR ACCORDIAN STEELGUARD	HARDWARE BY MFR		⚡	
1	EA	PERMANENT SFIC CORE	AS REQUIRED		626	BES

END OF SECTION

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SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Results:
  - 1. Glass and glazing for the following:
    - a. Windows.
    - b. Doors.
    - c. Storefront framing.
  - 2. Glazing sealants and accessories.
- B. Principal Products:
  - 1. Float glass.
  - 2. Fully tempered float glass.
  - 3. Insulating glass.

1.2 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site .

1.4 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 square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria.



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1.5 INFORMATIONAL SUBMITTALS

- A. Qualifications: Installer NACC Certificate or written quality management system.
- B. Product Test Reports: For insulating 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.
- C. Preconstruction adhesion and compatibility test report.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Installer Qualifications: NACC Certified or entity with written quality management system, approved by business owner, documenting home office, shop, and field procedures and operations to ensure compliance with Contract requirements.
- 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 C 1021 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 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.

1.7 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 C 1087 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.

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5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to 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.

#### 1.9 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.

#### 1.10 WARRANTY

- A. 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.
  1. Warranty Period: 10 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Guardian Glass, LLC; SunGuard Advanced Architectural Glass or comparable product by one of the following:
  1. Pilkington North America Inc.
  2. Viracon, Inc.
  3. Vitro Architectural Glass (formerly PPG).
- B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
  1. Obtain tinted glass from single source from single manufacturer.
  2. Obtain reflective-coated glass from single source from single manufacturer.

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- C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

## 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 the following:
  - 1. Defective manufacture, fabrication, or installation.
  - 2. Failure of sealants or gaskets to remain watertight and airtight.
  - 3. Deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.
- C. Structural Performance: Provide glazing capable of withstanding design loads within limits and under conditions indicated.
  - 1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
    - a. Wind Design Data: As indicated on Drawings.
  - 2. 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, whichever is less.
- D. Windborne-Debris-Impact Resistance: Exterior glazing shall comply with basic-protection testing requirements in ASTM E 1996 for Wind Zone 1 when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on Project and shall be installed in same manner as glazing indicated for use on Project.
  - 1. Large-Missile Test: For glazing located within 30 feet of grade.
  - 2. Small-Missile Test: For glazing located more than 30 feet above grade.
- E. Air Blast Resistance: Resist 6 psi for 41 milliseconds when tested in accordance with ASTM F1642 and meeting GSA/ISC Condition 3a High Protection Level.
  - 1. Glass cracks. Glass fragments land of floor 3.3 feet maximum distance from opening.
- F. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- G. 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, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.

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5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glazing values, according to 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. GANA Publications: "Glazing Manual."
  2. 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 IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
  1. Minimum Glass Thickness for Exterior Lites: 6 mm.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

## 2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as 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.
- C. Heat-Strengthened Float Glass: ASTM C 1048, 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.
  1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

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## 2.5 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
  - 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
  - 2. 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 selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

## 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
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces

## 2.8 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of 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: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

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- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, 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, ambient; 180 deg F, 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.

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- 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.
- 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.
- 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 according to 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 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.

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- 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 where indicated on Drawings.
- 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. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. 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 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.



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- 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 come into 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.

### 3.8 MONOLITHIC GLASS SCHEDULE

- A. Glass Type **GLS-2**: Laminated security glazing; refer to 088853 Security Glazing.
- B. Glass Type **GLS-3**: Clear fully tempered float glass.
  - 1. Minimum Thickness: 6 mm.
  - 2. Safety glazing required.
- C. Glass Type **GLS-4**: Fire resistant glazing; refer to 088813 Fire-Resistant Glazing.

### 3.9 INSULATING GLASS SCHEDULE

- A. Glass Type **GLS-1**: Bird-Friendly Etched Pattern, Low-E Coated security glass, Clear Insulating Vision Glass.
  - 1. Basis-of-Design Product: Guardian Glass, LLC; Bird1st Etch Pattern DX22 with SunGuard SNX 70+ on Clear.
  - 2. Overall Unit Thickness: 1 inch (25 mm).
  - 3. Minimum Thickness of Each Glass Lite: 6 mm.
  - 4. Outboard Lite: Guardian Clear float glass

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- a. Etch Pattern on No.1 Surface: Guardian Bird1st DX22 (Non-directional 5 mm dots, spaced 2" x 2" apart).
    - b. Low-E Coating on No.2 Surface: SNX 70+ sputtered on second surface.
    - c. Heat Treatment: Heat Strengthened or fully tempered.
  5. Etch Pattern Orientation: Installed at in-plane orientation angle as advised by supplier for intended bird collision deterrence benefit.
  6. Interspace: Argon filled, 1/2 inch (12 mm) wide, hermetically sealed.
  7. Inboard Lite: Guardian Clear float glass laminated with SchoolGuard SG4.
    - a. Heat Treatment: Heat Strengthened or fully tempered.
  8. Glass Unit Performance Characteristics:
    - a. Visible Light Transmittance: 66 percent minimum.
    - b. SGHC: 0.27 maximum.
    - c. Winter Nighttime U-Factor: 0.24 maximum.
    - d. Summer Daytime U-Factor: 0.21 maximum.
  9. Safety glazing where required.
- B. Glass Type **GLS-5**: Bird-Friendly Etched Pattern, Low-E Coated, Clear Insulating Vision Glass.
1. Basis-of-Design Product: Guardian Glass, LLC; Bird1st Etch Pattern DX22 with SunGuard SNX 70+ on Clear.
  2. Overall Unit Thickness: 1 inch (25 mm).
  3. Minimum Thickness of Each Glass Lite: 6 mm.
  4. Outboard Lite: Guardian Clear float glass.
    - a. Etch Pattern on No.1 Surface: Guardian Bird1st DX22 (Non-directional 5 mm dots, spaced 2" x 2" apart).
    - b. Low-E Coating on No.2 Surface: SNX 70+ sputtered on second surface.
    - c. Heat Treatment: Heat Strengthened or fully tempered.
  5. Etch Pattern Orientation: Installed at in-plane orientation angle as advised by supplier for intended bird collision deterrence benefit.
  6. Interspace: Argon filled, 1/2 inch (12 mm) wide, hermetically sealed.
  7. Inboard Lite: Guardian Clear float glass.
    - a. Heat Treatment: Heat Strengthened or fully tempered.
  8. Glass Unit Performance Characteristics:
    - a. Visible Light Transmittance: 66 percent minimum.
    - b. SGHC: 0.27 maximum.

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- c. Winter Nighttime U-Factor: 0.24 maximum.
  - d. Summer Daytime U-Factor: 0.21 maximum.
- 9. Safety glazing where required.
- C. Glass Type **GLS-7**: Bird-Friendly Etched Pattern, Low-E Coated, Ceramic or Silicone Coated Insulating Spandrel Glass.
  - 1. Basis-of-Design Product: Guardian Glass, LLC; Bird1st Etch Pattern DX22 with SunGuard SNX 70+ on Clear.
  - 2. Overall Unit Thickness: 1 inch (25 mm).
  - 3. Minimum Thickness of Each Glass Lite: 6 mm.
  - 4. Outboard Lite: Guardian Clear float glass.
    - a. Etch Pattern on No.1 Surface: Guardian Bird1st DX22 (Non-directional 5 mm dots, spaced 2" x 2" apart).
    - b. Low-E Coating on No.2 Surface: SNX 70+ sputtered on second surface.
    - c. Heat Treatment: Heat Strengthened or fully tempered.
  - 5. Etch Pattern Orientation: Installed at in-plane orientation angle as advised by supplier for intended bird collision deterrence benefit.
  - 6. Interspace: Argon filled, 1/2 inch (12 mm) wide, hermetically sealed.
  - 7. Inboard Lite: Guardian Clear float glass.
    - a. Coating on Surface #4: Black Spandrel.
    - b. Heat Treatment: Heat Strengthened or fully tempered.
  - 8. Glass Unit Performance Characteristics:
    - a. Visible Light Transmittance: 0 percent minimum.
    - b. SGHC: 0.21 maximum.
    - c. Winter Nighttime U-Factor: 0.24 maximum.
    - d. Summer Daytime U-Factor: 0.21 maximum.
  - 9. Safety glazing where required.
- D. Glass Type **GLS-8**: Bird-Friendly Etched Pattern, Low-E Coated, Ceramic or Silicone Coated Insulating Spandrel Glass.
  - 1. Basis-of-Design Product: Guardian Glass, LLC; Bird1st Etch Pattern DX22 with SunGuard SNX 70+ on Clear.
  - 2. Overall Unit Thickness: 1 inch (25 mm).
  - 3. Minimum Thickness of Each Glass Lite: 6 mm.
  - 4. Outboard Lite: Guardian Clear float glass.

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- a. Etch Pattern on No.1 Surface: Guardian Bird1st DX22 (Non-directional 5 mm dots, spaced 2" x 2" apart).
  - b. Low-E Coating on No.2 Surface: SNX 70+ sputtered on second surface.
  - c. Heat Treatment: Heat Strengthened or fully tempered.
5. Etch Pattern Orientation: Installed at in-plane orientation angle as advised by supplier for intended bird collision deterrence benefit.
6. Interspace: Argon filled, 1/2 inch (12 mm) wide, hermetically sealed.
7. Inboard Lite: Guardian Clear float glass.
  - a. Coating on Surface #4: Blue Spandrel; to be selected from fabricators full range of colors.
  - b. Heat Treatment: Heat Strengthened or fully tempered.
8. Glass Unit Performance Characteristics:
  - a. Visible Light Transmittance: 0 percent minimum.
  - b. SGHC: 0.21 maximum.
  - c. Winter Nighttime U-Factor: 0.24 maximum.
  - d. Summer Daytime U-Factor: 0.21 maximum.
9. Safety glazing where required.

END OF SECTION

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SECTION 088700 WINDOW FILM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Architectural Window Film:
  - 1. Low-E window film
  - 2. Bird Collision Deterrent Markers
  - 3. Perforated window film

1.2 PERFORMANCE REQUIREMENTS

- A. Tear Resistance:
  - 1. Minimum Graves Area Tear Strength of 1,050 lbs percent as measured on coated film product, without liner, per ASTM D1004.
- B. Adhesion to Glass:
  - 1. Minimum 9 lbs/in peel strength per ASTM D3330 (Method A).
- C. Flammability: Surface burning characteristics when tested in accordance ASTM E 84, demonstrating film applied to glass rated Class A for Interior Use:
  - 1. Flame Spread Index: no greater than 25.
  - 2. Smoke Developed Index: no greater than 55.
- D. Abrasion Resistance:
  - 1. Film shall have a surface coating that is resistant to abrasion such that less than 5 percent increase of transmitted light haze will result when tested in accordance to ASTM D 1044 using 100 cycles, 500 grams weight, and the CS10F Calibrase Wheel.

1.3 SUBMITTALS

- A. Submit under provisions of Section 013000.
- B. Product Data: Manufacturer's current technical literature on each product to be used, including:
  - 1. Manufacturer's Data Sheets.
  - 2. Preparation instructions and recommendations.
  - 3. Storage and handling requirements and recommendations.
  - 4. Installation methods.
- C. 3rd Party Test Report Submittal Requirements. Submit the following 3rd Party test reports indicating compliance with the test values listed in this section.
  - 1. Flammability Testing, ASTM E84.
- D. Verification Samples: For each film specified, two samples representing actual film color and pattern.

1.4 QUALITY ASSURANCE

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- A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years experience.
  - 1. Provide documentation that the adhesive used on the specified films is a Pressure Sensitive Adhesive (PSA).
- B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five years demonstrated experience in installing products of the same type and scope as specified.
  - 1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Follow Manufacturer's instructions for storage and handling.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

#### 1.6 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 recommended limits.

#### 1.7 WARRANTY

- A. At project closeout, provide to Owner or Owners Representative an executed current copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer:
  - 1. 3M Commercial Solutions, which is located at: 3M Center Bldg. 223; St. Paul, MN 55144-1000; Toll Free Tel: 888-650-3497; Tel: 651-737-1081; Fax: 651-737-8241
  - 2. Feather Friendly
- B. Substitutions: Not permitted.

#### 2.2 SINGLE PATTERNED FILM

- A. Sun Control Prestige 70 Glazing Film:
  - 1. Ultraviolet Rejected (ASTM E 903): Not less than 99 percent.
  - 2. Visible Light Transmission (ASTM E 903, ASTM E 308): Not more than 62 percent.
  - 3. Visible Light Rejected (ASTM E 903): Not less than 15 percent.
  - 4. Solar Heat Reduction: Not less than 21 percent.
  - 5. Glare reduction: Not less than 22 percent.

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- B. Bird Collision Deterrent Markers
  - 1. Large Scale Pro - Symmetry pattern 2" x 2".
  - 2. White.
- C. Perforated window film
  - 1. Material: Cast Vinyl
  - 2. Perforation pattern: Film 8170-P40: 40%
  - 3. Color: White on exterior, black on reverse side.
  - 4. Thickness: 4 mil (0.10 mm)
  - 5. Adhesive: Pressure-sensitive, removable
  - 6. Adhesive color: Clear
  - 7. Adhesive liner: Polyethylene-coated paper with a continuous, non-perforated paper liner
  - 8. Tensile strength: 4.2 lbs/in. (0.75 kg/cm) minimum

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. Film Examination:
  - 1. If preparation of glass surfaces is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.
    - a. Glass surfaces receiving new film should first be examined to verify that they are free from defects and imperfections, which will affect the final appearance.
  - 2. Do not proceed with installation until glass surfaces have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions.
  - 3. Commencement of installation constitutes acceptance of conditions.

#### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Refer to Manufacturer's installation instructions for methods of preparation for Impact Protection Adhesive or Impact Protection Profile film attachment systems.

#### 3.3 INSTALLATION

- A. Film Installation, General:
  - 1. Install in accordance with manufacturer's instructions.
  - 2. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.
  - 3. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.
  - 4. Apply film to glass and lightly spray film with slip solution.

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5. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.
6. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.
7. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.
8. If completing an exterior application, check with the manufacturer as to whether edge sealing is required.

#### 3.4 CLEANING AND PROTECTION

- A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.
- B. Touch-up, repair or replace damaged products before Substantial Completion.
- C. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

END OF SECTION



SECTION 088813 - FIRE-RESISTANT GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Fire-resistance-rated glazing.

1.2 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product; 12 inches square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For glass testing agency.
- B. Product Certificates: For each type of glass and glazing product, from manufacturer.
- C. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

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1.7 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 the remainder of the construction period.

1.8 WARRANTY

- A. Manufacturer's Special Warranty on 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
- B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

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 the following: defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.
- B. Laminated glass with intumescent interlayers: 120-minute fire-resistance-rated glazing with 450 deg F (250 deg C) temperature-rise limitation.

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. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."

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- B. Safety Glazing Labeling: Permanently mark glazing with certification label of the Safety Glazing Certification Council 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 C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Ultraclear Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear), with visible light transmission not less than 91 percent.
- C. Tempered Float Glass: ASTM C 1048, 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 C 1172. 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-RESISTANCE-RATED GLAZING

- A. Fire-Resistance-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-resistance ratings indicated, based on testing according to ASTM E 119 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 the glazing is approved for use in walls, and the fire-resistance rating in minutes.
- C. Laminated Glass with Intumescent Interlayers: Laminated glass made from multiple plies of uncoated, ultraclear float glass; with intumescent interlayers; and complying with 16 CFR 1201, Category II.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Technical Glass Products; Pyrostop or comparable product by one of the following:
    - a. GGI; Pyrobel.
    - b. Vetrotech Saint-Gobain; SGG Contraflam.

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## 2.6 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 C 920, 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. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 795.
    - b. GE Advanced Materials - Silicones; SilGlaze II SCS2800.
    - c. Tremco Incorporated; Spectrem 2.
  - 2. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- 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;
- D. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces

## 2.7 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of 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 C 1330, 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-Resistive 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.

## 2.8 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.
  - 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.

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- 2. Provide 1/8-inch 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 according to 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 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 where indicated.
- 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.

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- 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 washaway 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 come into 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 in each area of Project 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

SECTION 088853 - SECURITY GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes laminated glass for the following applications:
  - 1. Doors.
  - 2. Storefront framing.

1.2 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on security glazing, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 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 security glazing during and after installation.

1.4 SUBMITTALS

- A. Product Data: For each type of product.
- B. Security Glazing Samples: For each type of security glazing; 12 inches square.
- C. Security Glazing Schedule: List security glazing types and thicknesses for each size opening and location. Use same designations indicated on Drawings. Indicate coordinated dimensions of security glazing and construction that receives security glazing, including clearances and glazing channel dimensions.
- D. Qualification Data: For installers.
- E. Product Certificates: For each type of product indicated, from manufacturer.
- F. Product Test Reports: For each type of security glazing, for tests performed by manufacturer and witnessed by a qualified testing agency.
- G. Product Test Reports: For each type of glazing sealant, for tests performed by a qualified testing agency.



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1. Provide test reports based on testing current sealant formulations within previous 36-month period.

H. Preconstruction adhesion and compatibility test reports.

I. Sample Warranties: For special warranties.

#### 1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs glazing installers for this Project who are certified under the National Glass Association Glazier Certification Program.

B. Sealant Testing Agency Qualifications: Qualified according to ASTM C 1021 for testing indicated.

#### 1.6 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each security glazing type, tape sealant, gasket, glazing accessory, and glazing-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing will not be required if data based on previous testing of current sealant products and glazing materials match those submitted.
2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to security glazing, 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 sufficient 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 the use of specially formulated primers.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect security glazing and glazing materials according to manufacturer's written instructions. Prevent damage from condensation, temperature changes, direct exposure to sun, or other causes.

#### 1.8 PROJECT 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 condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

## 1.9 WARRANTY

- A. Manufacturer's Special Warranty on Laminated Glass: Manufacturer agrees to replace laminated glass that deteriorates 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: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations for Security Glazing: Obtain security glazing from single source from single manufacturer using the same types of lites, plies, interlayers, and spacers for each security glazing type indicated.
- B. Source Limitations for Glazing Sealants: Obtain from single source from single manufacturer for each product and installation method.

### 2.2 PERFORMANCE REQUIREMENTS

- A. General:
  - 1. Installed security glazing shall withstand security-related loads and forces without damage to the glazing beyond that allowed by referenced standards.
- B. Structural Performance: Glazing shall withstand the following:
  - 1. Design Wind Pressures: As indicated on Drawings.
  - 2. UL 972 Rating: 5-aa1 rated for 6 minutes
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glazing framing members and glazing components.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201.

### 2.3 SECURITY GLAZING, GENERAL

- A. Glazing Publications: Comply with published recommendations of security glazing and glazing material manufacturers and organizations below unless more stringent requirements are

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indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."

- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glazing, glass thickness, and safety glazing standard with which glazing complies.

## 2.4 LAMINATED GLASS

- A. Laminated Glass: Two outer layers of glass with custom security strengthened substrate core.
1. Basis-of-Design Product: Subject to compliance with requirements, provide LTI Smart Glass, Inc.; SchoolGuard SG4 or comparable product by the following:
    - a. Global Security Glazing: CHILDGARD security glazing.
  2. Color: Clear.
  3. Nominal Thickness: Manufacturer's standard.
  4. Provide safety glazing labeling.

## 2.5 INSULATING SECURITY GLAZING

- A. Insulating Security Glazing: Factory-assembled units, consisting of sealed lites of glazing material indicated separated by a dehydrated interspace.
1. Basis-of-Design Product: Subject to compliance with requirements, provide LTI Smart Glass, Inc.; SchoolGuard SG4 IGU with Bird1st Etch Pattern DX22 or comparable product by the following:
    - a. Global Security Glazing: CHILDGARD security glazing.
  2. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
  3. Spacer: Manufacturer's standard spacer material and construction Aluminum with mill or clear anodic finish Aluminum with black, color anodic finish Aluminum with bronze, color anodic finish Aluminum with powdered metal paint finish in color selected by Architect Galvanized steel Stainless steel Polypropylene-covered stainless steel in color selected by Architect Thermally broken aluminum Nonmetallic laminate Nonmetallic tube Insert material.
  4. Desiccant: Molecular sieve or silica gel, or blend of both.
  5. Refer to Section 088000 for IGU requirements.

## 2.6 GLAZING SEALANTS

- A. General:
1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they contact, including security glazing, seals of insulating security glazing and air-gap security glazing, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

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2. Suitability: Comply with sealant and security glazing 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 selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

## 2.7 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of security glazing 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: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by security glazing manufacturer to maintain security glazing lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit security glazing lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

## 2.8 FABRICATION OF SECURITY GLAZING

- A. Fabricate security glazing 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 for security glazing, with Installer present, for compliance with the following:
1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.

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2. Minimum required face or edge clearances.
3. Minimum required bite.
4. Effective sealing between joints of 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 security glazing 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 will leave visible marks in the completed work.

### 3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of security glazing, sealants, gaskets, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect edges of security glazing from damage during handling and installation. Remove damaged security glazing from Project site and legally dispose of off Project site. Damaged security glazing includes units with edge or face damage or other imperfections that, when installed, could weaken security glazing and impair performance and 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 glazing unit manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by security glazing manufacturers for installing lites.
- F. Provide spacers for security glazing lites where the length plus width is larger than 50 inches.
  1. Locate spacers directly opposite each other on both inside and outside faces of security glazing. 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 performance requirements.
  2. Provide 1/8-inch minimum bite of spacers on glazing lites 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 security glazing from moving sideways in glazing channel, as recommended in writing by security glazing manufacturer and according to requirements in referenced glazing publications.

- H. Set security glazing in each series with uniform pattern, draw, bow, and similar characteristics.
- I. 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.
- J. 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 by gasket manufacturer.

### 3.4 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 securely in place between glazing unit 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 security glazing 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. Compress gaskets to produce a weathertight seal without developing bending stresses in security glazing. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center security glazing in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in security glazing. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

### 3.5 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between security glazing and glazing stops to maintain face clearances and to prevent sealant from extruding into glazing channel and blocking weep systems. 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 security glazing and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial washaway from security glazing.

3.6 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect security glazing from contact with contaminating substances resulting from construction operations, including weld splatter. Examine glass surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, or stains.
  - 1. If, despite such protection, contaminating substances do come into contact with security glazing, remove substances immediately as recommended in writing by security glazing manufacturer. Remove and replace security glazing that cannot be cleaned without damage.
- C. Wash security glazing on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash security glazing as recommended in writing by security glazing manufacturer.

END OF SECTION

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## SECTION 090511 - CONCRETE FLOOR PREPARATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Mechanical cleaning of new and existing concrete floor surfaces for application of the following finishes:
    - a. Sealers.
    - b. Coatings.
    - c. Polymer overlays.

#### 1.2 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
  - 1. Review conditions affecting substrate preparation.
  - 2. Review procedures that will be used for substrate preparation.
  - 3. Require attendance by finish flooring installers to review preparation requirements of floor finish product and flooring adhesive manufacturers

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of mechanical cleaning equipment used on the project.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
  - 1. Submit report of observations.
  - 2. Certify installation is complete in accordance with manufacturer's instructions.
  - 3. Indicate supplementary instructions provided for Project specific conditions.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained in the use of the equipment and techniques required to produce the specified results.



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PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify new concrete floors have cured minimum 28 days.
- B. Examine substrates, with Installer present, for compliance with requirements for surface contamination, damage, and other conditions affecting performance of the Work.
- C. Examine substrate to determine repairs required to restore substrate surface to be within tolerances required for floor finishes specified in other sections, prior to completing Work of this section.
- D. Examine substrate to verify surfaces prepared in accordance with this section will be suitable for application of finishes specified in other sections.
- E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance with recommendations for methods and materials required to correct conditions before proceeding with work of this section.
- F. Proceed with surface preparation only after unsatisfactory conditions have been corrected.
  - 1. Proceeding with surface preparations indicates acceptance and of surfaces and conditions of substrate.

3.2 SURFACE PREPARATION EQUIPMENT

- A. Mechanical Cleaning Equipment: Automatic, dry shot blast type, self contained capable of recycling blast materials and collecting surface abrasions.

3.3 SURFACE PREPARATION

- A. Mechanically clean concrete substrate and create surface profile in existing concrete substrate in accordance with ASTM D 4259.
  - 1. Mechanically clean concrete substrate to remove surface and penetrating contaminants to produce a surface profile of ICRI CSP 3 in accordance with ICRI Technical Guideline No. 310.2.
  - 2. Acceptable substrate surfaces will be free of laitance, oil, grease, flooring adhesive, paint, and other surface contaminants capable of affecting bond of specified floor finishes to concrete substrate.
- B. Repair surface irregularities after cleaning.

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1. Fill bugholes, spalls, cracks, deteriorated joints and other surface damage exposed or created as a result of substrate cleaning operations flush with adjacent surfaces to provide sound substrate for specified floor finish.
- C. Dry broom or vacuum clean concrete substrates immediately before application of specified floor finishes in accordance with ASTM D 4258 to remove loose materials on substrate surface.
- D. When field quality control report indicates portions are unsatisfactory, repeat process until field quality control report indicates there are no unsatisfactory portions remaining.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
  1. Visual inspection of completed substrate preparation to verify contamination is removed.
  2. Visual inspection of completed substrate preparation to verify surface profile matches ICRI CSP 3, using ICRI standard rubber mold for visual comparison.
  3. Prepare field quality control report. Clearly indicate the locations, extents, and conditions of areas where surface preparation does not conform to specified profile and cleanliness. Document observed conditions with digital photographs.
  4. Repeat inspections when additional surface preparation for unsatisfactory conditions indicated in the previous field quality control report.

### 3.5 PROTECTION

- A. Protect prepared concrete substrates from contamination. Reclean substrates that are contaminated by construction operations prior to installation of specified floor finishes.

END OF SECTION

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SECTION 090512 - CONCRETE FLOOR MOISTURE CONTENT AND PH TESTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Concrete moisture content testing using water vapor emission method.
  - 2. Concrete moisture content testing using relative humidity method.
  - 3. Concrete pH testing.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
- B. Scheduling: Schedule work to permit concrete moisture testing to be completed minimum one week and maximum 3 weeks before floor coverings are installed.

1.3 ACTION SUBMITTALS

- A. Product Data:
  - 1. Submit model and manufacturer for calcium chloride test kits.
  - 2. Submit data indicating model, manufacturer, and calibration record for relative humidity measuring equipment.
  - 3. Submit data for floor slab treatment products.
- B. Shop Drawings:
  - 1. Indicate test locations shown on building floor plan,

1.4 INFORMATIONAL SUBMITTALS

- A. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- B. Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for concrete moisture acceptable limits.
- C. Test Reports: Report test results in chart form.
  - 1. Calcium Chloride Test Method: Indicate test dates, start/stop time, start/stop weight, weight gain in grams, water vapor emission rate, and pH levels.
  - 2. Relative Humidity Test Method: Indicate test dates, time, depth of test well, in-situ temperature, relative humidity and pH levels.

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3. Submit record of ambient air temperature, ambient relative humidity, and floor slab surface temperature when test sites are prepared, start of test, and end of test.
4. Indicate condition of building enclosure including position of operable windows and exterior doors when test sites are prepared, start of test, and end of test.
5. Submit transcript of datalogger.
6. Indicate operational status of HVAC systems maintaining environmental condition of spaces where tests are conducted when test sites are prepared, start of test, and end of test.

#### 1.5 QUALITY ASSURANCE

- A. Testing Agency: A qualified, independent testing agency employing ICRI Tier 2 Concrete Slab Moisture Testing Technician to perform tests.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver calcium chloride test kits to Project site in manufacturer's original, sealed packaging.
- B. Accept test kits on site. Inspect test kits for damage. Replace damaged test kits.

#### 1.7 FIELD CONDITIONS

- A. Ambient Conditions:
  1. Do not perform concrete moisture testing until building is enclosed and HVAC system is operational.
  2. Maintain building test areas at design operating conditions for minimum 48 hours before, during, and continuously after conducting testing.
  3. When HVAC system is not operational at start of tests, maintain ambient conditions within test areas at 65 to 85 degrees F and 40 to 60 percent relative humidity for minimum 48 hours before, during, and continuously after conducting testing until building HVAC system is capable of maintaining design operating conditions.

### PART 2 - PRODUCTS

#### 2.1 CALCIUM CHLORIDE TEST KITS

- A. Calcium Chloride Test Kit: Comply with ASTM F1869.

#### 2.2 RELATIVE HUMIDITY TEST EQUIPMENT

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  1. Vaisala [www.vaisala.com](http://www.vaisala.com).
- B. Humidity and Temperature Probe and Meter: Comply with ASTM F2170.

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## 2.3 pH TEST MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Micro Essential Laboratory [www.microessentiallab.com](http://www.microessentiallab.com).
- B. pH Test Paper: Capable of indicating minimum 7.0 to 13 pH range.
- C. pH Color Gage: Furnish pH test paper manufacturer's visual color gage to identify measured pH.
- D. Water: Distilled or deionized.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify new concrete floors have cured minimum 28 days.

### 3.2 PREPARATION

- A. When a building HVAC system is not operational and maintaining test areas at design operational conditions, install recording hygrometer or data logger in each separate test area to record ambient temperature and relative humidity beginning 48 hours before start of tests until completion of tests within each area.
- B. Identify three moisture test sites for first 1,000 sf and one moisture test site for each additional 1,000 sf of floor area receiving floor covering on each separate floor slab.
  - 1. Layout test site locations uniformly distributed throughout each test area.
- C. Mechanically clean each test site to remove oils, laitance, curing compounds, adhesives, and other contaminants affecting water vapor emissions.
  - 1. Remove cleaning residue.
  - 2. Do not apply water or other liquid to floor slabs and test sites.

### 3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform concrete moisture tests and inspections and prepare test reports.
- B. Acceptance Criteria:
  - 1. Concrete floor slabs will be considered acceptable for installation of floor finishes when:
    - a. Calcium Chloride Test Result: 3 lb of water/1000 sf in 24 hours maximum moisture vapor transmission rate.
    - b. Relative Humidity Test Result: 75 percent maximum relative humidity.
    - c. pH Test Result: Within alkalinity range of 7.0 to 9.0.

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2. When concrete floors do not meet acceptance criteria, obtain recommendations from floor finish manufacturers for remediation measures necessary to permit successful floor finish installation.
- C. Concrete Moisture Testing – General
  1. Conduct calcium chloride test and relative humidity test at each test site.
  2. Conduct one pH test at each test site.
- D. Calcium Chloride Testing:
  1. Perform tests in accordance with ASTM F1869.
- E. Relative Humidity Testing:
  1. Perform tests in accordance with ASTM F2170.
  2. Conduct relative humidity testing at the following depths:
    - a. Slabs-On-Grade: Measure temperature and relative humidity at 40 percent of slab thickness measured from top surface.
    - b. Elevated Slabs: Measure temperature and relative humidity at 20 percent of slab thickness measured from top surface.
  3. Drill test hole at each test site to accommodate test sleeve.
    - a. Hole Diameter: In accordance with test equipment manufacturer's instructions.
    - b. Drilling Fluids: Not permitted.
  4. Vacuum dust and debris from test hole.
  5. Insert sleeve, to the full depth of test hole. Cap or plug sleeve to prevent test hole contamination.
  6. Permit the test site to acclimate for minimum 72 hours before measuring relative humidity.
  7. Remove sleeve plug and insert probe to bottom of test hole. Allow test probe to reach temperature equilibration with concrete slab.
  8. Measure and record temperature and relative humidity at the test site.
- F. pH Testing:
  1. Place several drops of water onto the concrete surface to form a puddle approximately 1 inch in diameter.
  2. Allow the water to set for approximately 60 seconds
  3. After 60 seconds, dip the pH paper into the water and remove immediately, compare color to chart provided by paper supplier to determine pH reading.
  4. Record and report results.

END OF SECTION

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SECTION 090561.13 - MOISTURE VAPOR EMISSION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes fluid-applied, resin-based, membrane-forming systems that control the moisture-vapor-emission rate of high-moisture, interior concrete to prepare it for floor covering installation.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each MVE-control system, for tests performed by manufacturer and witnessed by a qualified testing agency.
- B. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Employs factory-trained personnel who are available for consultation and Project-site inspection.
- B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating directions for storage and mixing with other components.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Comply with MVE-control system manufacturer's written instructions for substrate and ambient temperatures, humidity, ventilation, and other conditions affecting system installation.

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1. Store system components in a temperature-controlled environment and protected from weather and at ambient temperature of not less than 65 deg F and not more than 85 deg F at least 48 hours before use.
2. Maintain ambient temperature and relative humidity in installation areas within range recommended in writing by MVE-control system manufacturer, but not less than 65 deg F or more than 85 deg F and not less than 40 or more than 60 percent relative humidity, for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.
3. Install MVE-control systems where concrete surface temperatures will remain a minimum of 5 deg F higher than the dew point for ambient temperature and relative humidity conditions in installation areas for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. MVE-Control System Capabilities: Capable of suppressing MVE without failure where installed on concrete that exhibits the following conditions:
  1. MVER: Maximum 15 lb of water/1000 sq. ft. when tested according to ASTM F1869.
  2. Relative Humidity: Maximum 100 percent when tested according to ASTM F2170 using in situ probes.
- B. Water-Vapor Transmission: Through MVE-control system, maximum 0.10 perm when tested according to ASTM E96/E96M.
- C. Tensile Bond Strength: For MVE-control system, greater than 200 psi with failure in the concrete according to ASTM D7234.

### 2.2 MVE-CONTROL SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Advanced Moisture Control, Inc.
  2. ARDEX Americas.
  3. BASF Corporation.
  4. Dependable, LLC.
  5. H.B. Fuller Construction Products Inc. / TEC.
  6. LATICRETE SUPERCAP, LLC.
  7. MAPEI Corporation.
  8. USG Corporation.
- B. MVE-Control System: ASTM F3010-qualified, fluid-applied, two-component, epoxy-resin, membrane-forming system; formulated for application on concrete substrates to reduce MVER



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to level required for installation of floor coverings indicated and acceptable to manufacturers of floor covering products indicated, including adhesives.

1. Substrate Primer: Provide MVE-control system manufacturer's concrete-substrate primer if required for system indicated by substrate conditions.
2. Cementitious Underlayment Primer: If required for subsequent installation of cementitious underlayment products, provide MVE-control system manufacturer's primer to ensure adhesion of products to MVE-control system.

## 2.3 ACCESSORIES

- A. Patching and Leveling Material: Moisture-, mildew-, and alkali-resistant product recommended in writing by MVE-control system manufacturer and with minimum of 3000-psi compressive strength after 28 days when tested according to ASTM C109/C109M.
- B. Crack-Filling Material: Resin-based material recommended in writing by MVE-control system manufacturer for sealing concrete substrate crack repair.
- C. Cementitious Underlayment: If required to maintain manufacturer's warranty, provide MVE-control system manufacturer's gypsum cement-based underlayment.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  1. Installation of system indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Preinstallation Testing:
  1. Testing Agency: Owner will engage a qualified testing agency to perform tests.
  2. Alkalinity Testing: Perform pH testing according to ASTM F710. Install MVE-control system in areas where pH readings are less than 7.0 and in areas where pH readings are greater than 8.5.
  3. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

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- a. Anhydrous Calcium Chloride Test: ASTM F1869. Install MVE-control system in locations where concrete substrate MVER exceeds 3 lb of water/1000 sq. ft. in 24 hours.
  - b. Internal Relative Humidity Test: Using in situ probes, ASTM F2170. Install MVE-control system in locations where concrete substrates exhibit relative humidity level greater than 75 percent.
4. Tensile-Bond-Strength Testing: For typical locations indicated to receive installation of MVE-control system, install minimum 100-sq. ft. area of MVE-control system to prepared concrete substrate and test according to ASTM D7234.
  - a. Proceed with installation only where tensile bond strength is greater than 200 psi with failure in the concrete.
- B. Concrete Substrates: Prepare and clean substrates according to MVE-control system manufacturer's written instructions to ensure adhesion of system to concrete.
  1. Remove coatings and other substances that are incompatible with MVE-control system and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by MVE-control system manufacturer. Do not use solvents.
  2. Provide concrete surface profile complying with ICRI 310.2R CSP 3 by shot blasting using apparatus that abrades the concrete surface with shot, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
  3. After shot blasting, repair damaged and deteriorated concrete according to MVE-control system manufacturer's written instructions.
  4. Protect substrate voids and joints to prevent resins from flowing into or leaking through them.
  5. Fill surface depressions and irregularities with patching and leveling material.
  6. Fill surface cracks, grooves, control joints, and other nonmoving joints with crack-filling material.
  7. Allow concrete to dry, undisturbed, for period recommended in writing by MVE-control system manufacturer after surface preparation, but not less than 24 hours.
  8. Before installing MVE-control systems, broom sweep and vacuum prepared concrete.
- C. Protect walls, floor openings, electrical openings, door frames, and other obstructions during installation.

### 3.3 INSTALLATION

- A. General: Install MVE-control system according to ASTM F3010 and manufacturer's written instructions to produce a uniform, monolithic surface free of surface deficiencies such as pin holes, fish eyes, and voids.
  1. Install primers as required to comply with manufacturer's written instructions.
- B. Do not apply MVE-control system across substrate expansion, isolation, and other moving joints.

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- C. Apply system, including component coats if any, in thickness recommended in writing by MVE-control system manufacturer for MVER indicated by preinstallation testing.
- D. Cure MVE-control system components according to manufacturer's written instructions. Prevent contamination or other damage during installation and curing processes.
- E. After curing, examine MVE-control system for surface deficiencies. Repair surface deficiencies according to manufacturer's written instructions.
- F. Install cementitious underlayment over cured membrane if required to maintain manufacturer's warranty and in thickness required to maintain the warranty.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform installation inspections.
- B. Installation Inspections: Inspect substrate preparation and installation of system components to ensure compliance with manufacturer's written instructions and to ensure that a complete MVE-control system is installed without deficiencies.
  - 1. Verify that surface preparation meets requirements.
  - 2. Verify that component coats and complete MVE-control-system film thicknesses comply with manufacturer's written instructions.
  - 3. Verify that MVE-control-system components and installation areas that evidence deficiencies are repaired according to manufacturer's written instructions.
- C. MVE-control system will be considered defective if it does not pass inspections.

### 3.5 PROTECTION

- A. Protect MVE-control system from damage, wear, dirt, dust, and other contaminants before floor covering installation. Use protective methods and materials, including temporary coverings, recommended in writing by MVE-control system manufacturer.
- B. Do not allow subsequent preinstallation examination and testing for floor covering installation to damage, puncture, or otherwise compromise the MVE-control system membrane.

END OF SECTION

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Non-load-bearing steel framing systems for interior partitions.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For firestop tracks, from ICC-ES.

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.
- A. Deflection Limits: Limit deflection of non-structural framed wall assemblies that have the following finishes based on horizontal loading of 5 lbf/sq. ft.
  - 1. Exposed Gypsum Board: L/240.
  - 2. Tile Finish: L/360.

2.2 FRAMING SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. California Expanded Metal Products Company (CEMCO).
  - 2. ClarkDietrich Building Systems
  - 3. Marino\WARE.

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4. Phillips Manufacturing Company.
5. Telling Industries, LLC.
- B. 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.
  2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.
- C. Studs and Tracks: ASTM C 645.
  1. Steel Studs and Tracks:
    - a. Minimum Base-Metal Thickness: As indicated on Drawings.
    - b. Depth: As indicated on Drawings.
- D. Slip-Type Head Joints: Provide one of the following:
  1. Single Long-Leg Track System: ASTM C 645 top track with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
  2. Double-Track System: ASTM C 645 top track, inside track with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction fit inside track.
  3. Deflection Track: Steel sheet top track 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. Products: Subject to compliance with requirements, provide one of the following:
      - 1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
      - 2) MBA Building Supplies; FlatSteel Deflection Track.
      - 3) Steel Network Inc. (The); VertiClip SLD Series.
      - 4) Superior Metal Trim; Superior Flex Track System (SFT).
      - 5) Telling Industries; Vertical Slip Track.
- E. Firestop Head of Wall Joints: See Division 07 Section "Joint Firestopping"
- F. Firestop Track:
  1. Top track 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.
    - a. CEMCO; California Expanded Metal Products Co.; FAS Track.
    - b. ClarkDietrich Building Systems; BlazeFrame DL 2.
    - c. Fire Trak Corp.; Fire Trak System.
    - d. Metal-Lite, Inc.; The System.
- G. Acoustical Furring Clip: Molded rubber and galvanized steel mount clip used to attach furring and gypsum wallboard wall or floor/ceiling assemblies.
  1. GenieClip as manufactured by Pliteq Inc.
- H. Blocking Material Options:

1. 6 inch wide, 0.0677 inch thick (14 gage) steel with 1-1/4 inch legs, pre notched 1/2 inch to fit 16 or 24 inch on center stud.
    - a. Flush-Mount Flat Reinforced Backing; as manufactured by Perfect Wall, Inc.
  2. 6 inch wide by 48 inches long, pre notched fire- retardant treated plywood with flexible connector plate including trimable plates for off-module backing, to fit 16 or 24 inch on center stud.
    - a. Danback; as manufactured by Dietrich.
  3. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
    - a. Minimum Base-Metal Thickness: As indicated on Drawings.
- I. Cold-Rolled Channel Bridging: Steel, 54 mils minimum base-metal thickness, with minimum 1/2-inch- wide flanges.
1. Depth: As indicated on Drawings.
  2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.
- J. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base-Metal Thickness: As indicated on Drawings.
  2. Depth: As indicated on Drawings.
- K. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.
1. Configuration: Asymmetrical or hat shaped.

## 2.3 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.

## 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 of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

### 3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
  - 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. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
  - 2. Multilayer Application: 16 inches o.c. unless otherwise indicated.
  - 3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks 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 and floor decks, 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 track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb unless otherwise indicated.
    - b. 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.

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- a. Firestop Track: Install where required to maintain continuity of fire-resistance-rated assembly indicated.
- 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- E. Direct Furring:
  - 1. Screw to wood framing.
  - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION



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SECTION 092116.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

1.1 SUMMARY

- A. Section Includes: Gypsum board shaft wall assemblies.

1.2 ACTION SUBMITTALS

- A. Product Data: For each component of gypsum board shaft wall assembly.

1.3 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For shaft wall assemblies and firestop tracks, from ICC-ES.

1.4 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.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or with gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install 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: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

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- B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.
- C. Deflection Limits: Limit deflection of shaft wall assemblies that have the following room-side finishes:
  - 1. Exposed Gypsum Board: L/240.

## 2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

- A. Fire-Resistance Rating: As indicated.
- B. STC Rating: As indicated.
- C. Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.
  - 1. Depth: As indicated.
  - 2. Minimum Base-Metal Thickness: 0.018 inch.
- D. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.
  - 1. Minimum Base-Metal Thickness: Matching steel studs.
- E. Firestop Tracks: Provide firestop track at head of shaft wall on each floor level.
- F. Room-Side Finish: Gypsum board.
- G. Shaft-Side Finish: Gypsum shaftliner board, Type X, Gypsum shaftliner board, moisture- and mold-resistant Type X.
- H. Insulation: Sound attenuation blankets.

## 2.3 PANEL PRODUCTS

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
- B. Gypsum Shaftliner Board, Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with paper faces.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; ProRoc Shaftliner.
    - b. Georgia-Pacific Gypsum LLC, Subsidiary of Georgia Pacific; ToughRock Fireguard Shaftliner.
    - c. National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner.
    - d. USG Corporation; Sheetrock Brand Gypsum Liner Panel.
  - 2. Thickness: 1 inch.
  - 3. Long Edges: Double bevel.

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- C. Gypsum Shaftliner Board, Moisture- and Mold-Resistant Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with moisture- and mold-resistant core and surfaces.
  - 1. Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; ProRoc Moisture and Mold Resistant Shaftliner.
    - b. Georgia-Pacific Gypsum LLC, Subsidiary of Georgia Pacific; Dens-Glass Ultra Shaftliner.
    - c. Lafarge North America, Inc.; Firecheck Moldcheck Type X Shaftliner.
    - d. National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner XP.
    - e. PABCO Gypsum; Pabcore Mold Curb Shaftliner Type X.
    - f. USG Corporation; Sheetrock Brand Mold Tough Gypsum Liner Panel.
  - 2. Thickness: 1 inch.
  - 3. Long Edges: Double bevel.
  - 4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- D. Gypsum Board: As specified in Section 092900 "Gypsum Board."

## 2.4 NON-LOAD-BEARING STEEL FRAMING

- A. Steel Framing Members: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
  - 1. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.
- B. 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 System attached to studs with Fire Trak Posi Klip.
    - b. Grace Construction Products; FlameSafe FlowTrak System.
    - c. Metal-Lite, Inc.; The System.
    - d. Steel Network Inc. (The); VertiClip SLD Series.

## 2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with manufacturer's written recommendations.
- B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written recommendations for application indicated.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
- 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.

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1. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing according to ASTM E 488 conducted by a qualified testing agency.
  2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing according to ASTM E 1190 conducted by a qualified testing agency.
- E. Sound Attenuation Blankets: As specified in Section 092900 "Gypsum Board."
- F. Acoustical Sealant: As specified in Section 092900 "Gypsum Board."

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates to which gypsum board shaft wall assemblies attach or abut, with Installer present, including hollow-metal frames, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance.
- 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 PREPARATION

- A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. 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 Fireproofing."
- B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

#### 3.3 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and ASTM C 754 other than stud-spacing requirements.

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- B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.
- C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
  - 1. Reinforcing: Where handrails directly attach to gypsum board shaft wall assemblies, provide galvanized steel reinforcing strip with 0.033-inch minimum thickness of base metal (uncoated), accurately positioned and secured behind at least one layer of face panel.
- D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.
- E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.
- F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- G. Control Joints: Install control joints at locations indicated on Drawings while maintaining fire-resistance rating of gypsum board shaft wall assemblies.
- H. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.
- I. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

### 3.4 IDENTIFICATION

- A. Identify fire rated walls and partitions and other walls required to have protected openings or penetrations effectively and permanently with signs or stenciling above accessible ceilings, repeated at intervals not exceeding 30 feet measured horizontally along walls and partitions.
- B. Include the following information in lettering not less than 3 inches high with 3/8 inch stroke:
  - 1. "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS."

### 3.5 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 panels that are wet, moisture damaged, or mold damaged.

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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

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SECTION 092400 - CEMENT PLASTERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal lath.
2. Accessories.
3. Base-coat cement plaster.
4. Cement plaster finish coats.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project Site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

- B. Shop Drawings: Locations and installation of control and expansion joints, including plans, elevations, sections, and attachment details.

- C. Samples for Initial Selection: For each type of factory-prepared finish coat and for each color and finish texture specified.

- D. Samples for Verification: For each type of factory-prepared finish coat and for each color and finish texture specified, 12 by 12 inches and prepared on rigid backing.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover, and keep them dry and protected against damage from weather, moisture, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.5 FIELD CONDITIONS

- A. Comply with ASTM C926 requirements.

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B. Exterior Plasterwork:

1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
2. Apply plaster when ambient temperature is greater than 40 deg F
3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.

C. Interior Plasterwork: Maintain room temperatures at greater than 40 deg F for at least 48 hours before plaster application, and continuously during and after application.

1. Avoid conditions that result in plaster drying out during curing period. Distribute heat evenly; prevent concentrated or uneven heat on plaster.
2. Ventilate building spaces as required to remove water in excess of that required for hydrating plaster in a manner that prevents drafts of air from contacting surfaces during plaster application and until plaster is dry.

D. Factory-Prepared Finish Coats: Comply with manufacturer's written instructions for environmental conditions for applying finish coats.

PART 2 - PRODUCTS

2.1 METAL LATH

- A. Expanded Metal Lath: ASTM C847; cold-rolled carbon steel sheet, hot-dip galvanized with ASTM A653/A653M zinc coating.

2.2 ACCESSORIES

- A. General: Comply with requirements in ASTM C1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

2.3 BASE-COAT CEMENT PLASTER

- A. General: Comply with requirements in ASTM C926 for applications indicated.

1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. yd. (0.6 kg of fiber/cu. m) of cementitious materials.
2. Aggregate:
  - a. Sand: Use unless otherwise indicated.



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- B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:

1. Portland Cement Mixes:

- a. Scratch Coat: For cementitious material, mix 1 part portland cement and **[3/4 to 1-1/2]** parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
- b. Brown Coat: For cementitious material, mix 1 part portland cement and [3/4 to 1-1/2] parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.

- C. Base-Coat Mix for Use over Solid Plaster Bases: Single base (scratch) coat for two-coat plasterwork as follows:

1. Low-Absorption Unit Masonry and Concrete Substrates:

- a. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 0 to 3/4 part lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
- b. .

2. High-Absorption Unit Masonry and Concrete Substrates:

- a. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.

## 2.4 CEMENT PLASTER FINISH COATS

- A. Ready-Mixed Finish-Coat Plaster: Factory-mixed portland cement, aggregates, coloring agents, and proprietary ingredients.

1. Color: As selected by Architect from manufacturer's full range.
2. Source Limitations: Obtain ready-mixed finish-coat plaster from single source from single manufacturer.

## 2.5 PLASTER MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I.

## 2.6 MISCELLANEOUS MATERIALS

Water containing salt, alum, or plaster residue accelerates plaster set and may cause efflorescence. Water containing organic or vegetable matter may retard plaster set, cause staining, and interfere with plaster bond.

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- A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

### 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. Reject plaster materials that are wet or moisture damaged.
- C. 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 smooth, solid substrates for plaster in accordance with ASTM C926.

#### 3.3 INSTALLATION OF METAL LATH

- A. Metal Lath: Install in accordance with ASTM C1063.

#### 3.4 APPLICATION OF BASE-COAT CEMENT PLASTER

- A. General: Comply with ASTM C926.
  - 1. Install so that finished plaster surfaces will not deviate more than plus or minus 1/4 inch in 10 ft. from a true plane when measured by a 10-ft. (3-m) straightedge placed on surface.

#### 3.5 APPLICATION OF CEMENT PLASTER FINISH COATS

- A. General: Comply with ASTM C926.
  - 1. 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.
  - 2. 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, groove finish coat at junctures with metal.

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3.6 REPAIR

- A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.7 CLEANING

- 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. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Interior gypsum board.
  - 2. Tile backing panels.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For the following products:
  - 1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

1.3 QUALITY ASSURANCE

- A. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Install mockups for the following:
    - a. Each level of gypsum board finish indicated for use in exposed locations.
    - b. Each texture finish indicated.
  - 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.

1.4 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.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

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- C. Do not install panels that are wet, those that are moisture damaged, and those that are 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 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 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Gypsum.
  - 2. CertainTeed Corp.
  - 3. Continental Building Products.
  - 4. Georgia-Pacific Gypsum LLC.
  - 5. National Gypsum Company.
  - 6. PABCO Gypsum.
  - 7. USG Corporation.
- B. Gypsum Board, Type X: ASTM C 1396/C 1396M.
  - 1. Thickness: 5/8 inch.
  - 2. Long Edges: Tapered.
- C. Impact-Resistant Gypsum Board: ASTM C 1629/C 1629M.
  - 1. Basis of Design Product: Georgia-Pacific; DensArmor Plus.
  - 2. Core: 5/8 inch, Type X.
  - 3. Surface Abrasion: Meets or exceeds Level 3 requirements.
  - 4. Surface Indentation: Meets or exceeds Level 1 requirements.

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5. Single-Drop Soft-Body Impact: Meets or exceeds Level 3 requirements.
6. Hard-Body Impact: Meets or exceeds Level 3 requirements according to test in Annex A1.
7. Long Edges: Tapered.
8. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

D. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Basis of Design Product: USG; Fiberock Aqua-Tough.
2. Core: 5/8 inch, Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

## 2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. C-Cure; C-Cure Board 990.
  - b. CertainTeed Corp.; FiberCement Underlayment.
  - c. Custom Building Products; Wonderboard.
  - d. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
  - e. James Hardie Building Products, Inc.; Hardiebacker.
  - f. National Gypsum Company, Permabase Cement Board.
  - g. USG Corporation; DUROCK Cement Board.
2. Thickness: 5/8 inch.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

## 2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:
  - a. Cornerbead.
  - b. Bullnose bead.
  - c. L-Bead: L-shaped; exposed long flange receives joint compound.
  - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
  - e. Expansion (control) joint.

## 2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Tile Backing Panels: As recommended by panel manufacturer.

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- C. Joint Compound for Interior Gypsum Board: Products compatible with substrate and other coatings applied to surface.
  - 1. Filling, Tape Embedding and Topping Coats: Products complying with ASTM C475 and recommended by gypsum board manufacturer for finish level specified.
  - 2. Skim Coat: For final coat of Level 5 finish, use drying-type, topping compound.
- D. Joint Compound for Tile Backing Panels:
  - 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
  - 2. Cementitious Backer Units: As recommended by backer unit manufacturer.

## 2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
  - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
  - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Sound Attenuation Blankets: ASTM C 665, 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.
- D. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. 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.
- E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- 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.

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### 3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- 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 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. 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- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- 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. 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 C 919 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.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

### 3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  - 1. Type X:As indicated on Drawings.



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2. Impact-Resistant Type: As indicated on Drawings.
3. Moisture- and Mold-Resistant Type: As indicated on Drawings.

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) 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-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 face 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 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-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.

### 3.4 APPLYING TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.
- B. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.
- C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

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### 3.5 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings.
- C. Interior Trim: Install in the following locations:
  - 1. Cornerbead: Use at outside corners unless otherwise indicated.
  - 2. Bullnose Bead: Use where indicated.
  - 3. L-Bead: Use where indicated.
  - 4. U-Bead: Use where indicated.

### 3.6 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 C 840:
  - 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 099123 "Interior Painting."
  - 4. Level 5: Where indicated on Drawings.
    - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

### 3.7 IDENTIFICATION

- A. Identify fire rated walls and partitions and other walls required to have protected openings or penetrations effectively and permanently with signs or stenciling above accessible ceilings, repeated at intervals not exceeding 30 feet measured horizontally along walls and partitions.
- B. Include the following information in lettering not less than 3 inches high with 3/8 inch stroke:
  - 1. "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS."

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3.8 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

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SECTION 093000 - TILING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Ceramic and Porcelain tile for:
    - a. Walls.
    - b. Floors.
  - 2. Stone thresholds.
  - 3. Waterproof membrane.
  - 4. Crack isolation membrane.
  - 5. Metal edge strips.

1.2 PERFORMANCE REQUIREMENTS

- A. Dynamic Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ANSI A137.1 by Dynamic Coefficient of Friction (DCOF) AcuTest:
  - 1. Level Surfaces: Minimum 0.42.

1.3 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 Verification:
  - 1. Full-size units of each type and composition of tile and for each color and finish required.
  - 2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches square, but not fewer than 4 tiles. Use grout of type and in color or colors approved for completed Work.
  - 3. Full-size units of each type of trim and accessory for each color and finish required.
  - 4. Stone thresholds in 6-inch lengths.
  - 5. Metal edge strips in 6-inch lengths.

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#### 1.4 INFORMATIONAL SUBMITTALS

- A. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- B. Product Certificates: For each type of product, signed by product manufacturer.
- C. Material Test Reports: For each tile-setting and -grouting product.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- 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 3 percent of amount installed 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.

#### 1.6 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain tile of each type and color or finish 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. Stone thresholds.
  - 2. Waterproof membrane.
  - 3. Crack isolation membrane.
  - 4. Joint sealants.
  - 5. 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 floor tile installation.
  - 2. Build mockup of each type of wall tile installation.
  - 3. 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.

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1.7 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.

1.8 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.
  - 2. 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 TCNA installation methods specified in tile installation schedules, and other requirements specified.
  - 1. Large Format Tile: Comply with ANSI A 118.5 series for tile installation standards.
    - a. Back buttering the tile to obtain 100 percent mortar coverage.
- 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.

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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.
- F. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide manufacturer's shapes as selected.

## 2.2 MANUFACTURERS

- A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide product as specified or comparable product by one of the following:
  1. Daltile; Division of Dal-Tile International Inc. as basis of design.
  2. American Olean; Division of Dal-Tile International Inc.
  3. Crossville, Inc.

## 2.3 TILE PRODUCTS, T-1, T-2, T-2B, T3, T-4, T-5, T6, T-7, T-8, T-9

- A. Ceramic and Porcelain Tile: ANSI A137.1, in sizes and thickness as indicated on Drawings.
  1. Basis of Design Products: See Finish Schedule on Drawings.

## 2.4 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
  1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.
- B. Marble Thresholds: ASTM C 503, with a minimum abrasion resistance of 10 per ASTM C 1353 or ASTM C 241 and with honed finish.
  1. Description: Uniform, fine- to medium-grained white stone with gray veining.

## 2.5 TILE BACKING PANELS

- A. Type as specified in Section 092900 "Gypsum Board."

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## 2.6 WATERPROOF MEMBRANE

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.
  - 1. Products: Subject to compliance with requirements, provide one of the following :
    - a. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
    - b. Laticrete International, Inc.; Laticrete Blue 92 Anti-Fracture Membrane and 9235 Waterproof Membrane.
    - c. MAPEI Corporation; Mapelastic HPG with MAPEI Fiberglass Mesh.
    - d. Merkrete, Inc.; Hydro-Guard 2000 Waterproof and Anti-Fracture Membrane.

## 2.7 CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch nominal thickness.
  - 1. Products: Subject to compliance with requirements, provide one of the following :
    - a. Noble Company (The); Nobleseal CIS.
    - b. Merkrete, Inc.; Fracture Guard 7000.

## 2.8 SETTING MATERIALS

- A. Latex-Portland Cement Mortar (Thin Set-Small Format Tile 12 inches or less in any direction): ANSI A118.4.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
    - a. Custom Building Products; Versa Bond.
    - b. Laticrete International, Inc.; 253 Gold Thinset Set Mortar.
    - c. MAPEI Corporation; UltraFlex 2 Thin Set.
    - d. Merkrete Inc.; 7D10 Latex Thin Set Mortar.
  - 2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.
- B. Latex-Portland Cement Mortar (Medium Bed/LHT Thin Set-Large Format Tile Mortar 12 inches or greater in any direction): ANSI A118.4 and ANSI A118.15.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Custom Building Products; ProLite.
    - b. Laticrete International, Inc.; 4 XLT.
    - c. MAPEI Corporation; UltraFlex LFT.



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d. Merkrete Inc.; 820 Merlite.

C. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
  - a. Custom Building Products.
  - b. Laticrete International, Inc.
  - c. MAPEI Corporation.
  - d. Merkrete Inc.; Pro Epoxy Grout.
2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 deg F and 212 deg F, respectively, and certified by manufacturer for intended use.

## 2.9 GROUT MATERIALS

A. Water-Cleanable Epoxy Grout: ANSI A118.3.

1. Manufacturers: Subject to compliance with requirements, provide products as indicated on Finish Schedule or comparable product by one of the following :
  - a. Custom Building Products.
  - b. Laticrete International, Inc.
  - c. MAPEI Corporation.
  - d. Merkrete Inc..

B. Grout Color: See Finish Schedule.

## 2.10 ELASTOMERIC SEALANTS

A. As specified in Section 079200 "Joint Sealants."

1. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.

## 2.11 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: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications.

1. Basis of Design Product: See Finish Schedule

C. 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.

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- D. Grout Sealer: Grout manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout or tile.

## 2.12 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, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work as specified in Section 090511 "Concrete Floor Preparation."
  - 1. Proceed with application only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Concrete Substrates:
  - 1. Prepare substrate according Section 090511 "Concrete Floor Preparation."
  - 2. Concrete Testing: As specified in Section 090512 "Concrete Floor Moisture Content and pH Testing."
- 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 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.

### 3.3 TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic Tile Installation" for TCNA 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 TCNA installation

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methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
  - a. Tile floors in wet areas.
  - b. Tile floors composed of tiles 8 by 8 inches or larger.
- 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. Ceramic Tile: 1/16 inch.
  2. Porcelain Tile: 1/16 inch.
- F. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- G. 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."
- H. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
  1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thin set).
  2. Do not extend waterproofing/anti fracture membrane or crack isolation membrane under thresholds set in latex-portland cement mortar. Fill joints between such thresholds and adjoining tile set on waterproofing/anti fracture or crack isolation membrane with elastomeric sealant.

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- I. Metal Edge Strips: Install at locations indicated.
- J. Grout Sealer: Apply grout sealer to cementitious grout joints 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. Comply with Section 092900 "Gypsum Board."

### 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 CRACK ISOLATION MEMBRANE INSTALLATION

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.
- B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

### 3.7 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 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.

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- D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

### 3.8 INTERIOR TILE INSTALLATION SCHEDULE

- A. Interior Wall Installations, Metal Studs or Furring:
  - 1. Tile Installation W243: Thin-set mortar on gypsum board; TCNA W243.
    - a. Thin-Set Mortar: Latex- portland cement mortar.
    - b. Grout: High performance cement unsanded grout.
  - 2. Tile Installation W244C: Thin-set mortar on cementitious backer units; TCNA W244.
    - a. Thin-Set Mortar: Latex- portland cement mortar.
    - b. Grout: High performance cement unsanded grout.

END OF SECTION

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SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. 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 Samples of each type, color, pattern, and texture.
  - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- long Samples of each type, finish, and color.

1.4 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 manufacturer and witnessed by a qualified testing agency.
- C. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

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- D. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes 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. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed.
  - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
  - 3. Hold-Down Clips: Equal to 2 percent of quantity installed.
  - 4. Impact Clips: Equal to 2 percent of quantity installed.

#### 1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.

#### 1.8 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.

#### 1.9 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.
  - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

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## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. 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: 50 or less.
- C. Fire-Resistance Ratings: Comply with ASTM E 119; 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 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. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.
- C. 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 away from test surface according to ASTM E 795.
- D. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

### 2.3 ACOUSTICAL PANELS, ACT-1, ACT-2, ACT-3

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products as indicated in Finish Schedule on Drawings or comparable product by one of the following:
  - 1. Armstrong World Industries, Inc.
  - 2. CertainTeed Corp.
  - 3. Rockfon.
  - 4. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Color: See Finish Schedule on Drawings.



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- C. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

## 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.
  - 1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- 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. Type: Postinstalled expansion or Postinstalled bonded anchors.
    - b. 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.
    - c. 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.
    - d. 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. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
  - 3. 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- diameter wire.
- D. Hanger Rods or Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch- thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.

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- F. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- H. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place.
- I. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.
- J. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

## 2.5 METAL SUSPENSION SYSTEM

- A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products as indicated on Drawings or comparable product by one of the following:
  - 1. Armstrong World Industries, Inc.
  - 2. CertainTeed Corp.
  - 3. Rockfon.
  - 4. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation; with prefinished 02/11-inch- wide metal caps on flanges.
  - 1. Structural Classification: Intermediate-duty system.
  - 2. End Condition of Cross Runners: butt-edge type.
  - 3. Face Design: Flat, flush.
  - 4. Cap Material: Steel or aluminum cold-rolled sheet.
  - 5. Cap Finish: Painted in color as selected from manufacturer's full range.

## 2.6 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. Rockfon.
  - 4. Fry Reglet Corporation.
  - 5. Gordon, Inc.
  - 6. USG Interiors, Inc.; Subsidiary of USG Corporation.

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- B. 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.
  - 3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

## 2.7 ACOUSTICAL SEALANT

- A. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
  - 1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.

## PART 3 - EXECUTION

### 3.1 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.

### 3.2 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.

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### 3.3 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."
  - 1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- 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 and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, 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.
  - 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, postinstalled 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 o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches 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 postinstalled 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.

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1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
  3. 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. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
  2. 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.
  3. Install hold-down or impact 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.

### 3.4 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

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SECTION 096000 – ACOUSTICAL UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes Vulcanized Composition Rubber Sound Underlayment.
- B. Related Sections: Section(s) related to this section include:
  - 1. Concrete Substrate
  - 2. Resilient Flooring

1.2 REFERENCES

- A. Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
- B. American Society for Testing and Materials (ASTM International):
  - 1. Refer to PART 2 for additional information.

1.3 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide Vulcanized Composition Rubber resilient sound underlayment, which has been manufactured and installed to maintain performance criteria stated by manufacturer without defects, damage or failure.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Submit shop drawings showing layout, profiles and product components, including anchorage, accessories, finish colors, patterns and textures.
- C. Samples: Submit selection and verification samples for thicknesses, finishes, colors and textures.
- D. Quality Assurance Submittals: Submit the following:
  - 1. Certificates: If required, certification of performance characteristics specified in this document shall be provided by the manufacturer.
  - 2. Manufacturer's Instructions: Manufacturer's installation instructions.

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1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of resilient sheet flooring to include in maintenance manuals.
- B. Warranty: Warranty documents specified herein.

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. Furnish not less than 10 linear feet Insert dimension for every 500 linear feet or fraction thereof, in roll form and in full roll width for each type, color, and pattern of flooring installed.

1.8 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Installer Qualifications: Installer experienced in performing work of this section who has specialized in installation of work similar to that required for this project
    - a. Certificate: When requested, submit certificate indicating qualification.
  - 2. Manufacturer's Qualifications: Manufacturer capable of providing field service representation during construction and approving application method.
- B. Regulatory Requirements: [specify applicable requirements of regulatory agencies].
- C. Mock-Ups: Install at project site a job mock-up using acceptable products and manufacturer approved installation methods. Obtain Owner and Architect's acceptance of finish color, texture and pattern, and workmanship standard. Comply with Division 1 Quality Control (Mock-Up Requirements) Section.
  - 1. Mock-Up Size: [10'x10' min].
  - 2. Maintenance: Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.
  - 3. Incorporation: Mock-up may be incorporated into final construction upon Owner's approval.
- D. Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's instructions and manufacturer's warranty requirements. Comply with Division 1 Project Management and Coordination (Project Meetings) Section.
- E. Pre-installation Testing: Conduct pre-installation testing as required by the finish flooring manufacturer.

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1.9 DELIVERY, STORAGE & HANDLING.

- A. General: Comply with Division 1 Product Requirements Sections.
- B. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact
- D. Storage and Protection: Store materials at temperature and humidity conditions recommended by manufacturer and protect from exposure to harmful weather conditions.

1.10 FIELD CONDITIONS

- A. Temperature Requirements: Maintain air temperature in spaces where products will be installed for time period before, during and after installation as recommended by manufacturer.
- B. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1.11 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
- B. 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.
- C. Provide manufacturer's warranty commencing from Date of Substantial Completion

PART 2 - PRODUCTS

2.1 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Ecore
  - a. Address: 715 Fountain Ave., Lancaster, PA 17601; Telephone: (800) 322-1923, (717) 295-3400; Fax: (717) 295-3414; Email: [salesupport@ecoreintl.com](mailto:salesupport@ecoreintl.com)
- 2. Manufacturers/Products that meet material and performance requirements with specified and validated third party testing, are acceptable. "Equal products" shall be required to be pre-submitted and approved.



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## 2.2 PRODUCT DETAILS

- A. BOD: QTscu 4002 Vulcanized Composition Rubber impact sound insulation Underlayment

<b>QTscu Vulcanized Composition Rubber Resilient Impact Sound Insulation</b> QTscu is a flat, resilient underlayment used directly under a variety of floor finishes, yielding exceptional results for impact sound insulation and substrate crack isolation. Made from a formulation of high quality, postconsumer Vulcanized Composition Rubber granules, encapsulated in a wear and water-resistant elastomeric network		
<b>Performance Criteria</b>	<b>Test Method</b>	<b>Result</b>
Sheet Dimensions	Manufacturer	QTscu rolled rubber underlayment will have an overall nominal thickness of 1/8" [2 MM] standard in 4'x75' roll
Dimensional Tolerances	Manufacturer	Roll width: + 1/2" - 1/4" Roll length: +1% - 0" Thickness: ± 0.4mm
Impact Insulation Class (Lab)	ASTM E492	Specified floor-ceiling assembly must be tested in a fully accredited laboratory, compliant with the international accreditation standard (ISO/IEC 17025)
Field Impact Insulation Class	ASTM E1007	Floor-ceiling assembly must meet requirement as stated by building code and/or acoustical consultant.
Density	ASTM D297	50 lbs./ft <sup>3</sup> / 0.80 g/cm, min., typical
Tensile Strength	ASTM D412, Die C	80 psi, min
Tear Strength	ASTM D624, Die C	30 ppi, min
Compression @ 100 psi recovery	ASTM F36	20-30%, 85%, min.
Shore A Hardness	ASTM D2240	50 to 58
Flexibility	ASTM F147	1 factor, max.
Compression Set B, 25% Deflection, 158°/22 hrs.	ASTM D2240	40% max.
Crack Resistance	ANSI 118.12.5.4	High Performance
VOCs / CHPS / CA 01350	ASTM D5116	Pass

## 2.3 SOURCE QUALITY

- A. Source Quality: Obtain recycled rubber resilient flooring materials from a single manufacturer

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PART 3 - EXECUTIONASTM D395

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.

3.2 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work as specified in Division 09 Section "Concrete Floor Preparation."
  - 1. Proceed with application only after unsatisfactory conditions have been corrected

3.3 PREPARATION

- A. Surface Preparation: Surface shall be prepared in accordance with manufacturer's instructions
- B. Concrete Substrates:
  - 1. Prepare substrate according Division 09 Section "Concrete Floor Preparation."
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install underlayment until it is the same temperature as the space where it is to be installed.
  - 1. At least 48 hours in advance of installation, move underlayment and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered.

3.4 ERECTION/INSTALLATION/APPLICATION/CONSTRUCTION

- A. Installation: Comply with manufacturer's Technical Manual for installation procedures and techniques.
- B. Related Products Installation: Refer to other sections listed in Related Sections paragraph herein for related products installation.
- C. Installation should not begin until all other trades are finished in the area.
- D. Areas to receive the Vulcanized Composition Rubber Impact Sound Insulation should be weather tight and maintained at a minimum uniform temperature of 65°F (18°C) for 48 hours before, during, and after the installation.

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3.5 FIELD QUALITY REQUIREMENTS

- A. Manufacturer's Field Services: Upon Owner's request, provide manufacturer's field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer's instructions.

3.6 CLEANING AND PROTECTION

- A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Remove construction debris from project site and legally dispose of debris.
- B. Protection: Protect installed product and finish surfaces from damage during construction.

END OF SECTION

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PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Section: 03 30 00 - Cast-in-place Concrete
- B. Section: 06 10 00 - Rough Carpentry

1.2 SUMMARY

- A. Factory Finished Wood Flooring and associated trim
- B. Maintenance materials
- C. Sound Control Underlayment

1.3 ACTION SUBMITTALS

- A. Submit product data in accordance with Section 01 33 00, including manufacturer's installation and maintenance instructions.
- B. Shop Drawings: For each type of floor assembly and accessory. Include plans, sections, and attachment details. Include expansion provisions and trim details.
- C. Samples: Submit three representative samples of flooring [4" x 9"] in the final color and species, as selected by the Architect.

1.4 MAINTENANCE MATERIALS SUBMITTALS

- A. Some flooring material (attic stock) should be set aside in case future repairs are needed.

1.5 QUALITY ASSURANCE

- A. Installer: Shall be experienced in the wood and/or vinyl tile flooring industry and shall have a minimum of five (5) years' experience in the installation of similar products.
- B. Verify with the Architect that the flooring is the correct species, color, width, grain, finish (gloss level) and quality (fit) prior to installation. If there is any doubt, do not install the flooring. Contact Manufacturer immediately.

1.6 STORAGE, DELIVERY, AND HANDLING

- A. Cartons of wood should be stored in dry, well-ventilated storage areas or warehouses. Never store cartons of flooring outdoors. The idea storage environment should be maintained at 30-55% relative humidity and 60-80°F (15-26°C). Do not store cartons of flooring directly on warehouse floors.
- B. Deliver the flooring to a preferred 60-80°F (15-26°C), 30-55% relative humidity job site in unopened cartons. Protect flooring from exposure to moisture.
- C. Cartons of flooring will arrive to the job site wrapped in a polyethylene bag and typically shrink-wrapped to maintain the flooring at its most desirable installation moisture content. If material needs to be inspected prior to flooring installation, carefully remove the shrink-wrap and lift off polybag. After inspecting, put polybag back over pallet of flooring and secure with tape until installation. **DO NOT REMOVE ENGINEERED FLOORING FROM THE POLYBAG UNTIL THE DAY OF INSTALLATION. (*THE POLYBAG IS DIRECTLY BENEATH THE SHRINK WRAP*)**. Flooring that has not been used within a day should be returned to the polybag until ready for installation. No acclimation time is necessary or desired when installing Flooring. Temperature of material and adhesives should be acclimated to 60-80°F (15-26°C).

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1.7 FIELD CONDITIONS

- A. Provide permanent HVAC operation (2 week minimum) and permanent lighting prior to installation.
- B. Maintain room temperature between 60°F (15°C) minimum and 80°F (26°C). The ideal relative humidity for flooring installation is between 30% and 55%, prior, during and after the installation. Keep in mind that if the relative humidity drops below 30% for extended periods, the flooring could shrink causing surface splits and gaps.
- C. Do not install flooring until all other significant construction work is complete. Moisture producing activities such as drywall, concrete, masonry, painting and grouting must be complete and cured.

1.8 WARRANTY

- A. Limited Wear Through Warranty (10 years for commercial applications)

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hardwood Flooring: Comply with NWFA A500 for species, grade, and cut.
- B. Fire Ratings: Class I rating when tested in accordance with ASTM E-648.

2.2 FACTORY-FINISHED WOOD FLOORING

- A. Basis of Design Product: Nydree Engineered Acrylic Infused Hardwood Flooring or approved equal.
  - 1. Species and Color:
    - a. Maple (Natural finish)
  - 2. Size:
    - a. Width: 4"
    - b. Thickness: Nominal Thickness: 7/16", Actual Thickness: 0.430"
    - c. Length: Random 12" to 47"
  - 3. Edge Style: Micro-bevel
  - 4. Finish: Standard factory-applied urethane containing ceramic particles (15 gloss matte).

2.3 ACCESSORY MATERIALS:

- A. Wood Flooring Adhesive / Moisture Retarder.
  - 1. Install with manufacturer's recommended adhesive.
- B. Non-Infused Reducers/Transition Strips: Non-infused and stained to match flooring species/color
- C. Non-Infused Stair Accessories: Non-infused and stained to match flooring species/color

PART 3 EXECUTION

3.1 EXAMINATION

- A. All Subfloors

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1. Verify that the substrate is clean, sound and free of wax, dirt, dust, mold, mildew, loose material, grease, oil, coatings, paint, rust, asphalt cutback, old adhesives (carpet), weak powdery concrete or gypsum, adhesive removers, efflorescence and other surface contaminants that will interfere with the bonding of the adhesive. Scouring using 3 ½ (20 grit) open coat sandpaper can remove most of these materials.
2. Verify that the substrate is flat to within 3/16" in 10 ft. The substrate must be smooth, free from cracks, holes, voids, ridges, projections and other defects impairing performance or appearance.
3. Provide 1/4" expansion spacing at all vertical obstructions when flooring run is less than 25 feet. 1/2" expansion spacing at all vertical obstructions when flooring run is >25 to 50 feet. For runs >50 feet in either the length or width direction allow 1" expansion spacing at all vertical obstructions. Keep in mind that these expansion spacing recommendations are provided solely to help prevent catastrophic flooring failure in the event of flooding or long periods of relative humidity beyond 55%. If it is expected that the relative humidity in the installation environment never exceeds 55% RH, the correct application of SB1587 is used based on concrete moisture test results and there is never any wet mopping of the flooring, then an expansion spacing of more than 1/2" at all vertical obstructions is not necessary.
4. Coordinate work with that of other trades prior to installation so that no discrepancies may exist with the installation of doors, frames, saddles, floor drains or any materials that would interfere in any other way.
5. Notify Architect of moisture test results and any unsatisfactory conditions. Do not begin installation until unsatisfactory conditions have been corrected. Beginning of installation means substrate and job site conditions have been accepted as suitable.

### 3.4 PROTECTION

- A. Protect finished floor from abuse by other trades using heavy kraft paper, FortiBoard™ Floor Protector Paper or equivalent. Make sure the floor has been cleaned thoroughly (swept, vacuumed and dust mopped) prior to protecting, so that the flooring surface will not be scratched by debris. Avoid covering the installation with protective paper or equivalent for at least 24 hours. Keep traffic out of spaces and areas where flooring is being installed until adhesive has set. Light foot traffic after 10-12 hours. Normal traffic after 24 hours.

### 3.5 CLEANING

- A. Flooring Sealed with manufacturers' recommended sealant: Prior to turning the floor over to the owner, It shall be thoroughly cleaned by sweeping, vacuuming or dust mopping to remove debris, followed by cleaning with manufacturer's recommended surface cleaner.

END OF SECTION

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SECTION 096420 – WOOD GYMNASIUM FLOORING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Related work specified under other sections.

1. CONCRETE SUBFLOORS

- a. Concrete Slab Depression: 2 1/8" (54mm) using 25/32" (20mm) flooring and subfloor.
- b. Surface Finish: steel troweled and finished smooth.
- c. Concrete Tolerance: +/- 1/8" (3mm) in radius of 10' (3m).
- d. Floor Flatness and Floor Levelness (FF and FL) numbers are not recognized.
- e. Compressive Strength: Concrete shall be a minimum of 3,000 psi (21 MPa) and a maximum of 4000 psi (28MPa) compressive strength after 28 days. Concrete shall be free of washed river gravel, pea gravel, flint or hardener additives. No lightweight concrete.
- f. High spots shall be ground level and low spots shall be filled in with approved leveling compound by the general contractor to meet the tolerance above.

2. MEMBRANE WATERPROOFING - SECTION 07

- a. Concrete subfloors on or below grade shall be adequately waterproofed beneath the slab and at the perimeter walls and on earth side of below grade walls by general contractor using suitable type membrane.
- b. Sand-Poly-Sand slab construction is not an acceptable construction.

3. THRESHOLDS - SECTION 08

1.2 REFERENCES

- A. MFMA - Maple Flooring Manufacturers Association
- B. MFMA PUR – Performance Uniformity Requirements
- C. DIN 108032 (part 2) 2001 - Performance Test
- D. DIN 108032 (part 2) 1991 - Performance Test
- E. ASTM F2772 - Athletic Performance Properties of Indoor Sports Floor Systems
- F. EN 14904 – European Committee for Standardization – Surfaces for Sports areas
- G. ASTM F2772 - Athletic Performance Properties of Indoor Sports Floor Systems
- H. FIBA – International Basketball Federation
- I. FSC – Forest Stewardship Council

1.3 QUALITY ASSURANCE

A. Manufacturer

1. Basis-of-Design Product: Subject to compliance with requirements, provide products as indicated in the Finish Schedule on Drawings or comparable product.

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2. The manufacturer of resilient flooring shall be a firm specializing in manufacturing products specified in this section.
3. Manufacturer of flooring and subfloor components must be ISO 9001:2008 Certified to assure quality control of materials provided.

B. Installer (Flooring Contractor)

1. The complete installation of the flooring system, as described in the scope of these specifications, shall be carried out by an experienced installer (Flooring Contractor), and the work shall be performed in accordance with most recent installation instructions of the manufacturer. The installer must be approved by flooring system manufacturer and must have a minimum (10) years' experience.
2. Installer (Flooring Contractor) shall be liable for all matters related to installation for a period of two years after the floor has been substantially installed and completed.

C. Performance Testing

1. Flooring system shall have been independently tested and meets or exceeds all Athletic Performance requirements according to:
  - a. The MFMA-PUR Performance Standard
  - b. The International Standard DIN 18032 Part 2.
  - c. EN 14904 Standard
2. Independent DIN testing laboratory shall have Scientific Body Membership in the International Association of Sports Surface Sciences (ISSS). Test equipment shall have been calibrated and certified through the ISSS.

D. Floor System Design

1. System construction shall include manufactured method of stop blocking throughout entire floor for protective resilient pad housing and full subfloor support under significant non-athletic loads.
2. Resilient pads shall be aligned perpendicular to flooring direction, average spacing of 10" (254mm) on center.
3. Closed cell polyethylene foam shall not be included as a resilient component.
4. System design shall provide a minimum of 26.6 cubic inches of airspace between the concrete surface and underside of subfloor per square foot of floor area.

1.4 SUBMITTALS

- A. Product Data: For each type of product
- B. Shop Drawings: For each type of floor assembly and accessory. Include plans, sections, and attachment details. Include expansion provisions and trim details. Include striping material and layout drawings.



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- C. Samples for Verification: For each type of wood flooring and accessory, with stain color and finish required, approximately 12 inches (300 mm) long and of same thickness and material indicated for the Work and showing the full range of normal color and texture variations expected.
- D. Maintenance Literature - Upon completion of floor installation, send to owner, attendants or individuals in charge and responsible for the upkeep of the building a CARE CARD. This card spells out care and maintenance instructions including temperature and humidity ranges for areas where flooring is installed.

#### 1.5 WORKING CONDITIONS

- A. The wood flooring specified herein shall not be installed until all masonry, painting, plaster, tile, marble and terrazzo work is completed, and overhead mechanical trades and painters have finished in the wood floor areas. The building shall be enclosed and weathertite.
- B. The concrete subfloor shall be determined dry by industry standard testing procedures, free of foreign materials and turned over to the installer (Flooring Contractor) broom clean. Moderate room temperature of 65 degrees (18 degrees Celsius) or more shall be maintained a week preceding and throughout the duration of the work. Humidity conditions within the building shall approximate the humidity conditions that will prevail when the building is occupied.
- C. Permanent heat, light and ventilation shall be installed and operating during and after installation, maintaining a range of temperature and humidity compatible with the expected low and high moisture content of the flooring. The wood moisture content range is determined by the flooring contractor based on the facility's mechanical controls and/or geographical location.
- D. Flooring must be stored in a dry, well-ventilated area, not in contact with masonry, to acclimate to building conditions and shall be installed at moisture content compatible with the normally expected environmental range of temperature and relative humidity achieved while the facility is occupied.
- E. General Contractor shall lock floor area after floor is finished to allow proper curing time. If general contractor or owner requires use of gym after proper curing time, he shall protect the floor by covering with non-marring Kraft paper or red rosin paper with taped joints until acceptance by owner of complete gymnasium floor.
- F. Working conditions as described above shall be followed. Variations and substitutions shall be submitted for approval to the architect who shall advise Connor of the same.

#### 1.6 HUMIDITY CONTROL

- A. Since all wood flooring will expand and contract as relative humidity varies, it is important to minimize extremes between low and high. Hardwood flooring is manufactured at moisture content most compatible with a 35%-50% relative humidity range. Geographical regions and available mechanicals determine the typical range of temperature and humidity for each facility. Maintaining a 15% fluctuation between highest and lowest average indoor relative humidity

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provides limited shrinkage and growth. Facility managers should make use of available HVAC systems to prevent excessive tightening and shrinkage of flooring.

#### 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. Wood Flooring: Equal to 5 percent of amount installed for each type, color, and finish of wood flooring indicated.

#### 1.8 MANUFACTURER WARRANTY

- A. Guarantee shall not cover damage caused in whole or in part by casualty, ordinary wear and tear, abuse, use for which material is not designed, faulty construction of the building, settlement of the building walls, failure of the other contractors to adhere to specifications, separation of the concrete slab and excessive dryness or excessive moisture from humidity, spillage, migration through the slab or wall, or any other source.
- B. Material to be free from manufacturing defects for a period of 1 year. This warranty is in lieu of all other warranties, expressed or implied including but not limited to any warranty of merchantability or fitness for a particular purpose, and of any other obligations on the part of the manufacturer. In the event of breach of any warranty, the liability of the manufacturer shall be limited to repairing or replacing material and system components supplied by manufacturer and proven to be defective in manufacture, and shall not include any other damages, either direct or consequential.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Vapor Barrier - 6-mil (0.2mm) polyethylene.
- B. Manufacturer
  - 1. Basis of design shall be Robbins Eclipse products as indicated in the Finish Schedule on Drawings, or approved equal.
  - 2. Products/manufacturers that meet material and performance requirements with specified and validated third party testing, are acceptable. "Equal products" shall be required to be pre-submitted and approved.
- C. Subfloor Construction

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1. Robbins Eclipse subfloor panels with factory-attached resilient pads, or approved equal
- D. Flooring
  1. Eco-Friendly 25/32" (20mm) thick x 2 1/2" (63mm) facewidth; 2-1/4" (57mm) facewidth available at mill discretion; 2nd & Better grade; Factory Sanded Advantage™ XL (Non-Factory Sanded maple available as contractor option); T&G and EM, KD Northern Hard Maple; Continuous Strip XLplus™ Flooring as manufactured by Robbins and graded in accordance with MFMA-FJ rules. Flooring will have XLplus™ technology to reduce or eliminate routine spacing for expansion.
  2. Grade: 2nd and Better
    - a. Options (delete or modify above):
    - b. 1st Grade
    - c. 3rd and Better
- E. Fasteners
  1. Flooring – 1-3/4" (45mm) barbed cleats or staples.
  2. Subfloor – 1-5/8" to 1-3/4" (40mm) subflooring nails or staples.
  3. Channel anchors - 1-1/2" (38mm) long steel Powers SPIKE® anchors or Tapcons
- F. Finishing materials
  1. MFMA approved sealer
  2. MFMA approved finish
- G. Gamelines
  1. Gameline paint(s) shall be recommended by the finishing materials manufacturer, and must be compatible with the finish.
- H. Perimeter
  1. 3" x 4" ventilating type. (black)

### PART 3-EXECUTION

#### 3.1 INSPECTION

- A. Inspect concrete slab for proper tolerance and dryness, and report any discrepancies to the general contractor and architect in writing. Slab will be level to within 1/8" (3mm) in a 10' (3m). Moisture content of the concrete slab shall not exceed 85% using ASTM F 2170 In-Slab Relative Humidity test.
- B. All work required to put the concrete subfloors in acceptable condition shall be the responsibility of the general contractor.
- C. Subfloor shall be broom cleaned by general contractor.
- D. Installer shall document all working conditions provided in General Specifications prior to commencement of installation.

#### 3.2 INSTALLATION

- A. VAPOR BARRIER

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1. Install polyethylene with joints lapped a minimum of 6" (150mm) and turned up 4" (100mm) at the walls.
- B. SUBFLOOR
  1. Position Eclipse subfloor panels per manufacturer's instructions, integrating top layer with adjacent panels. Allow for a ¼" (6mm) gap at subfloor panel end joints. Provide 1-½" to 2" (40 to 50mm) expansion void at the perimeter and all vertical obstructions.
  2. Install solid blocking at doorways, under bleachers in the stacked position, and below portable goals.
  3. Install Bleacher Blocking per manufacturer's recommendations.
  4. Properly anchor subfloor panels at each factory designated location.
- C. FLOORING
  1. Machine nail maple flooring along each edge of the Eclipse panel's upper layer, driving up all end joints and proper spacing provided for humidity conditions in specific regions. Consult your local Robbins "Certified" contractor. Provide 2" (50mm) expansion voids at the perimeter and at all vertical obstructions.

### 3.3 FINISHING

#### A. SANDING

1. Sand per manufacturer's recommendations.
2. After sanding, buff entire floor using 100 grit screen or equal grit sandpaper, with a heavy-duty buffing machine.
3. Inspect entire area of floor to insure the floor presents a smooth surface without drum stop marks, gouges, streaks or shiners.
4. Vacuum and/or tack floor before first coat of seal.
5. Floor should be clean and completely free of dirt and sanding dust.

#### B. FINISHING

1. Apply specified combination of seal, gameline paint, and finish in accordance with manufacturer's instructions.
2. Buff and vacuum and/or tack between each coat after it dries.
3. Apply game lines accurately after the buffing and vacuuming the coated surfaces. Game lines shall be painted between seal coats and finish coats. Layout in accordance with drawings. For game lines, use current rules of association having jurisdiction. Lines shall be straight with sharp edges in colors selected by architect.

### 3.4 WALL BASE INSTALLATION

- A. Install vent cove base anchored to walls with base cement or screws. Use pre-mold outside corners and neatly mitered inside corner.

### 3.5 CLEANING

- A. Install vent cove base anchored to walls with base cement or screws. Use pre-mold outside corners and neatly mitered inside corner.

END OF SECTION

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Results:
  - 1. Resilient base.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.
- C. Product Schedule: For resilient base and accessory products.

1.3 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 than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.4 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 or more than 90 deg F.

1.5 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F , 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. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

- C. Install resilient products after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

### 2.1 RESILIENT BASE

- A. B-1: Basis of Design Manufacturer: Subject to compliance with requirements, provide products as indicated in Finish Schedule on Drawings or comparable by one of the following:
  - 1. Johnsonite as basis of design.
  - 2. Burke Mercer Flooring Products, Division of Burke Industries Inc.
  - 3. Flexco.
  - 4. Roppe Corporation, USA.
- B. B-2: Basis of Design Manufacturer: Subject to compliance with requirements, provide products as indicated in Finish Schedule on Drawings or comparable by one of the following:
  - 1. Johnsonite as basis of design.
  - 2. Burke Mercer Flooring Products, Division of Burke Industries Inc.
  - 3. Flexco.
  - 4. Roppe Corporation, USA.

### 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 resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

## 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 as specified in Division 09 Section "Concrete Floor Preparation."
  - 1. Proceed with application only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Concrete Substrates:
  - 1. Prepare substrate according Section 090511 "Concrete Floor Preparation."
  - 2. Concrete Testing: As specified in Section 090512 "Concrete Floor Moisture Content and pH Testing."
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are the same temperature as the space where they are to be installed.
  - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

### 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 practical 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. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
    - a. Form without producing discoloration (whitening) at bends.
  - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
    - a. Miter or cope corners to minimize open joints.

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3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
  - 1. Remove adhesive and other blemishes from exposed surfaces.
- 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 subject to wear and foot traffic until Substantial Completion.

END OF SECTION



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SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Vinyl composition floor tile.
- B. Related Sections: Sections related to this section include:
  - 1. Acoustical Underlayment

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- 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 Verification: Full-size units of each color and pattern of floor tile required.
  - 1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.
- D. Product Schedule: For floor tile.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 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. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

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1.6 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 or more than 90 deg F. Store floor tiles on flat surfaces.

1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, 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. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient tile flooring, 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.

2.2 VINYL COMPOSITION FLOOR TILE, VCT-1, VCT-2, VCT-3

- A. Basis of Design Manufacturer: Subject to compliance with requirements, provide products as indicated in Finish Schedule, or approved equal.
- B. Tile Standard: ASTM F 1066 tile.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

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- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

### 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 as specified in Division 09 Section "Concrete Floor Preparation."
  - 1. Proceed with application only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates:
  - 1. Prepare substrate according to Division 09 Section "Concrete Floor Preparation."

#### 3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  - 1. Lay tiles in pattern indicated.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
  - 1. Lay tiles with grain running in one direction.
- D. 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.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

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- F. 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 marking device.
- G. 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.
- H. 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 protecting 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 from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
  - 1. Apply one coat(s).
- E. Cover floor tile until Substantial Completion.

END OF SECTION

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SECTION 096623 - RESINOUS MATRIX TERRAZZO FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Thin-set, epoxy-resin terrazzo flooring and base.
  - 2. Precast epoxy-resin terrazzo units.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include terrazzo installation requirements. Include plans, elevations, sections, component details, and attachments to other work. Show layout of the following:
  - 1. Divider strips.
  - 2. Control-joint strips.
  - 3. Abrasive strips.
  - 4. Terrazzo patterns.
- C. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo sample to identify manufacturer's matrix color and aggregate types, sizes, and proportions. Prepare Samples of same thickness and from same material to be used for the Work, in size indicated below:
  - 1. Terrazzo: 6-inch- square Samples.
  - 2. Accessories: 6-inch- long Samples of each exposed strip item required.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type of terrazzo material or product, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For terrazzo to include in maintenance manuals.

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1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Engage an installer who is a contractor member of NTMA.
- B. Source Limitations: Obtain primary terrazzo materials from single source from single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.
- C. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.
- 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 mockups for terrazzo including accessories.
    - a. Size: Minimum 100 sq. ft. of typical poured-in-place flooring and base condition for each color and pattern in locations directed by Architect.
  - 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.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.
- B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.
- B. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.
- C. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.
- D. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.

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- E. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. NTMA Standards: Comply with NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.

### 2.2 EPOXY-RESIN TERRAZZO

- A. Epoxy-Resin Terrazzo: Comply with NTMA's "Terrazzo Specifications and Design Guide" and manufacturer's written instructions for matrix and aggregate proportions and mixing.
  - 1. Products: Subject to compliance with requirements, provide product as indicated on Finish Schedule on Drawings or comparable one from of the following:
    - a. Terrazzo & Marble Supply Companies; Terroxy Resin Systems.
    - b. Crossfield Products Corp., Dex-O-Tex Division; Cheminert.
    - c. General Polymers; Sherwin Williams; Terrazzo 1100.
    - d. Key Resin Company; Key Epoxy Terrazzo.
    - e. Master Terrazzo Technologies LLC; Morricite.
    - f. Quadrant Chemical Corporation; Quadset Epoxy Terrazzo.
    - g. TEC Specialty; H.B. Fuller Construction Products Inc; Tuff-Lite Epoxy Terrazzo.
  - 2. Thickness: 1/2 inch nominal.
  - 3. Formulated Mix Color and Pattern: See Finish Schedule.
- B. Materials:
  - 1. Flexible Reinforcing Membrane: Manufacturer's resinous membrane for substrate-crack preparation and reflective-crack reduction.
    - a. Reinforcement: Fiberglass scrim.
  - 2. Primer: Manufacturer's product recommended for substrate and use indicated.
  - 3. Epoxy-Resin Matrix: Manufacturer's standard recommended for use indicated and in color required for mix indicated.
    - a. For Epoxy Matrix blended with three volumes of Valders marble blended 60% #1 chip and 40% #0 chip, ground and grouted with epoxy resin according to Installation Specifications, finishing to a nominal 3/8" (9.5 mm) thickness. All specimens cured for 7 days at 73-77°F (22.8-25°C) and 50 percent RH plus or minus 2 percent RH.
  - 4. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.
    - a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C 131.
    - b. 24-Hour Absorption Rate: Less than 0.75 percent.
    - c. Dust Content: Less than 1.0 percent by weight.
  - 5. Finishing Grout: Epoxy Matrix or Clear Resin with a broadcast of limestone filler as recommended by manufacturer..

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### 2.3 PRECAST EPOXY-RESIN TERRAZZO

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products as indicated on Finish Schedule on Drawings or comparable product by one of the following:
  - 1. Precast Terrazzo Enterprises, Inc.
  - 2. Romoco Precast Terrazzo Products.
- B. Precast Terrazzo Units: Comply with NTMA's written recommendations for fabricating precast terrazzo units in sizes and profiles indicated. Reinforce units as required by unit sizes, profiles, and thicknesses and as recommended by manufacturer. Finish exposed-to-view edges and reveals to match face finish. Ease exposed edges to 1/8-inch radius.
  - 1. Precast Terrazzo Base Units: 1/4 inches thick, cast in maximum lengths possible, but not less than 36 inches.
    - a. Type: Square
    - b. Height: 4 inches.
    - c. Outside Corner Units: With finished returned edges at outside corner.
  - 2. Precast Terrazzo Stair Treads: Thickness indicated with cast-in nosing.
    - a. Tread/Riser: 1/2 inch thick epoxy, with abrasive strips.
  - 3. Color, Pattern, and Finish: As indicated on Finish Schedule on Drawings.

### 2.4 STRIP MATERIALS

- A. Thin-Set Divider Strips: L-type angle, 3/8 inch deep.
  - 1. Material: Aluminum.
  - 2. Top Width: 1/8 inch .
- B. Top-Section Width: As indicated
- C. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.
- D. Abrasive Strips: Three-line abrasive inserts at nosings, unless otherwise indicated. Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.
  - 1. Width: 1/2 inch.
  - 2. Depth: As required by terrazzo thickness.
  - 3. Length: As indicated.
  - 4. Color: Match Architect's sample.
- E. Reducer Strip: Provide Schluter Reno-U as indicated on Drawings.

### 2.5 MISCELLANEOUS ACCESSORIES

- A. Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use.



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- B. Crack Reduction Flexible Reinforcing Membrane:
  - 1. Basis of Design: Iso-Crack Epoxy Membrane or approved comparable product,
- C. Anchoring Devices:
  - 1. Precast Terrazzo: Provide mechanical anchoring devices as recommended by fabricator for proper anchorage and support of units for conditions of installation and support.
- D. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- E. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.
- F. Resinous Matrix Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.
- G. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; is recommended by sealer manufacturer; and complies with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.
  - 1. Surface Friction: Not less than 0.6 according to ASTM D 2047.
  - 2. Acid-Base Properties: With pH factor between 7 and 10.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and 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, including levelness tolerances, have been corrected.

#### 3.2 PREPARATION

- A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.
- B. Concrete Slabs:
  - 1. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with terrazzo.
    - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.

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- b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written recommendations.
  - c. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.
- C. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
  - 1. Moisture Testing: Perform tests indicated below.
    - a. Calcium Chloride Test: Perform anhydrous calcium chloride test per ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
      - 1) Perform tests so that each test area does not exceed 200 sq. ft., and perform not less than two tests in each installation area and with test areas evenly spaced in installation areas.
    - b. In-Situ Probe Test: Perform relative-humidity test using in-situ probes per ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative-humidity-level measurement.
    - c. Test Method: Test for moisture content by method recommended in writing by terrazzo manufacturer. Proceed with installation only after substrates pass testing.
- D. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.
  - 1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

### 3.3 EPOXY-RESIN TERRAZZO INSTALLATION

- A. Comply with NTMA's written recommendations for terrazzo and accessory installation.
- B. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions and NTMA's "Terrazzo Specifications and Design Guide."
- C. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet; noncumulative.
- D. Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.
- E. Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted.
- F. Flexible Reinforcing Membrane:
  - 1. Prepare and prefill substrate cracks with membrane material.
  - 2. Install membrane in areas to receive terrazzo.
  - 3. Reinforce membrane with fiberglass scrim.

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4. Prepare membrane according to manufacturer's written instructions before applying substrate primer.

G. Primer: Apply to terrazzo substrates according to manufacturer's written instructions.

H. Strip Materials:

1. Divider and Control-Joint Strips:
  - a. Locate divider strips in locations indicated.
  - b. Install control-joint strips in locations indicated.
  - c. Install control-joint strips with 1/4-inch gap between strips, and install sealant in gap.
  - d. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.
2. Accessory Strips: Install as required to provide a complete installation.
3. Abrasive Strips: Install with surface of abrasive strip positioned 1/16 inch higher than terrazzo surface.

### 3.4 PRECAST TERRAZZO INSTALLATION

- A. Install precast terrazzo units using method recommended by NTMA and manufacturer unless otherwise indicated.
- B. Do not install units that are chipped, cracked, discolored, or not properly finished.
- C. Seal joints between units with joint compound matching precast terrazzo matrix unless otherwise indicated.

### 3.5 REPAIR

- A. Cut out and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

### 3.6 CLEANING AND PROTECTION

- A. Cleaning:
  1. Remove grinding dust from installation and adjacent areas.
  2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.
- B. Sealing:
  1. Seal surfaces according to NTMA's written recommendations.

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2. Apply sealer according to sealer manufacturer's written instructions.
- C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

END OF SECTION

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SECTION 096723 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Industrial resinous flooring systems and cove base.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- B. Samples for Verification: For each resinous flooring system required, 6 inches square, applied to a rigid backing by Installer for this Project.
- C. Product Schedule: For resinous flooring. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each resinous flooring component, from manufacturer.
- B. Material Test Reports: For each resinous flooring system.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of flooring systems required for this Project.
- B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
- C. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Apply full-thickness mockups on 48-inch- square floor area selected by Architect.

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- a. Include 48-inch length of integral cove base with inside and outside corner.
2. Simulate finished lighting conditions for Architect's review of mockups.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Preinstallation Conference: Conduct conference at Project site.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application unless manufacturer recommends a longer period.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated or comparable product by one of the following:
  1. SikaFloor as basis of design.
  2. Sherwin Williams
  3. Tnemec Company, Inc.

#### 2.2 INDUSTRIAL RESINOUS FLOORING EP-1

- A. Resinous Flooring: Abrasion-, impact- and chemical-resistant, industrial-aggregate-filled, resin-based, monolithic floor surfacing designed to produce a seamless floor and integral cove base.
- B. Basis of Design Product: Sikafloor Purcem 22
  1. System Characteristics:
    - a. Self-Leveling Mortar: Sikafloor-22NA PurCem is a self-levelling, medium to heavy duty, solid color, three-component, water dispersed polyurethane-based / cement

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and aggregate screed. It is designed to provide excellent resistance to abrasion, impact, chemical attack and other physical aggression.

- b. Aggregates: See Finish Schedule on Drawings for products, including colors
- c. Top Coat: See Finish Schedule on Drawings for products, including colors
- d. Cove base: Sikafloor PurCem VG

## 2.3 ACCESSORIES

- A. Primer: Type recommended by manufacturer for substrate and body coats indicated.
- B. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
- B. Concrete Substrates: Prepare substrate per Section 090511 "Concrete Floor Preparation."
  - 1. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
  - 2. Test floors per Section 090512 "Concrete Floor Moisture Content and PH Testing."
- C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

### 3.2 APPLICATION

- A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
  - 1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
  - 2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
  - 3. At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.

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- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
  - 1. Integral Cove Base: 4 inches high.
- D. Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, remove trowel marks and roughness using method recommended by manufacturer.
- E. Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat and to produce wearing surface indicated.
- F. Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.

### 3.3 PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION



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SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes modular carpet tile.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 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.

1.3 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. Pattern type, location, and direction.
  - 7. Pile direction.
  - 8. Type, color, and location of insets and borders.
  - 9. Type, color, and location of edge, transition, and other accessory strips.
  - 10. 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- long Samples.
- D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

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1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- 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.

1.6 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. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.
- B. 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.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.

1.9 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.

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- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

#### 1.10 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, more than 10 percent edge raveling, snags, runs, dimensional stability, excess static discharge, loss of tuft bind strength, loss of face fiber, and delamination.
  - 3. Warranty Period: 15 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 CARPET TILE

- A. Basis of Design Products: See Finish Schedule on Drawings for products, including colors and patterns.
- B. Antimicrobial Treatment: Manufacturer's standard material.
  - 2. Critical Radiant Flux Classification: Not less than Class 1 0.45 W/sq. cm.

#### 2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, 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.
- C. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and dimensions as indicated on Drawings..

### 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 as specified in Division 09 Section "Concrete Floor Preparation."

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### 3.2 PREPARATION

- A. General: Comply with CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Concrete Substrates:
  - 1. Prepare substrate according Division 09 Section "Concrete Floor Preparation."
  - 2. Concrete Testing: As specified in Section 090512 "Concrete Floor Moisture Content and pH Testing."

### 3.3 INSTALLATION

- A. General: Comply with CRI 104 Section 10, "Carpet Tile" and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.
- 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 11.0, "Post Installation."

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- 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

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SECTION 096816 – SHEET CARPETING

PART 1 – GENERAL

1.1 SUMMARY

- A. This section relates to broadloom.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to carpet 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.

1.3 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.
  - 2. Carpet type, color, and dye lot.
  - 3. Type of subfloor.
  - 4. Type of installation.
  - 5. Pattern of installation.
  - 6. Pattern type, location, and direction.
  - 7. Pile direction.
  - 8. Type, color, and location of insets and borders.
  - 9. Type, color, and location of edge, transition, and other accessory strips.
  - 10. 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: 17"x24" full size sample.
  - 2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- long Samples.
- D. Product Schedule: For carpet, Use same designations indicated on Drawings.

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#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For carpet, for tests performed by a qualified testing agency.
- B. Sample Warranty: For special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet to include in maintenance manuals. Include the following:
  - 1. Methods for maintaining carpet, 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.

#### 1.6 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. Carpet: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

#### 1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Instructions
- B. Warranty Documents

#### 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Installer who has been trained in the installation of broadloom flooring.
- B. Mockups at designated location for architect review and approval.

#### 1.9 MATERIAL STORAGE AND HANDLING

- A. Store rolls on a flat surface, away from vents and direct sunlight.
- B. Store in protected dry conditions between 65 and 85 degrees.

#### 1.10 SITE CONDITIONS

The following conditions must be maintained for 24 hours prior to, during and permanently after installation:

- A. HVAC System must be operational.

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- B. The installation site, carpet and adhesive must be between 65°F and 95°F.
- C. The installation site's ambient relative humidity must not exceed 65%.
- D. Conduct relative humidity or Anhydrous Calcium Chloride testing. Results must be within the proper range for the adhesive
- E. Conduct pH testing on the floor in several locations. A reading below 5.0 or above 9.0 requires corrective measures.

## PART 2 – PRODUCTS

### 2.1 SHEET CARPETING

- A. Basis of Design Products: See Finish Schedule on Drawings for products, including colors and patterns

### 2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, 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.
- C. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and dimensions as indicated on Drawings.
- D. Seam Sealer: Seam sealer recommended by carpet manufacturer.

## 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 as specified in Division 09 Section "Concrete Floor Preparation."

### 3.2 PREPARATION

- A. General: Comply with CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Concrete Substrates:
  - 1. Prepare substrate according to Division 09 Section "Concrete Floor Preparation."



2. Concrete Testing: As specified in Section 090512 "Concrete Floor Moisture Content and pH Testing.

### 3.3 LAYOUT AND INSTALLATION

- A. Using roll sequencing, dry lay the entire area to be carpeted.
- B. Trim the seam edges with tools and techniques best suited for carpet. Row cut both edges. Broadloom products containing a white marker yarn on one side of the selvage approximately 1" from the selvage edge should be removed first. The opposite side should then be cut in order to achieve proper pattern match.
- C. Apply the adhesive with a 1/8" X 1/8" X 1/8" "U" notch trowel that will give a spread rate of 8 to 10 square yards per gallon or 32 to 40 square yards per 4-gallon pail. The adhesive is ready for carpet installation when the entire ridge of glue becomes tacky.
- D. Place the first breadth of the carpet into the adhesive and apply seam sealer, following with the second breadth pattern matching if necessary. Use a power stretcher, mini-stretcher, stay nails or deadman to obtain proper match.
- E. Seal the seams with with manufacturer's recommended seam sealer.
- F. Roll the carpet in both directions with a 75 to 100 lb. roller. Remove stay nails after the adhesive sets.
- G. Where carpet meets other floor coverings, the edges must be adequately protected with an appropriate transition molding or strip that covers the carpet edge at least 1/2".
- H. Use floor protection if heavy objects are moved within 24 hours after installation.
- I. Place a non-staining building material paper over the carpet to protect it when additional construction activity is to take place. Do not use plastic sheeting as it will trap moisture.

### 3.4 MAINTENANCE

- A. Preventative Floor Care
  1. Use protective chair mats under chairs with casters.
  2. Use soil removal mats at exterior entrances.
  3. Use absorbent mats in areas where moisture, oil and grease are present.
- B. Routine Maintenance
  1. Set a schedule depending on traffic and vacuum regularly.

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2. Remove spots with spot removers as soon as they occur.
3. Use encapsulation agents periodically.
4. Clean with hot water extraction periodically.

Traffic Level	Vacuum	Spot Removal	Interim Cleaning	Hot Water Extraction
Light	2/week	As needed	As needed	1/year
Moderate	1/day	As needed	As needed	1/year
Heavy	1/day	As needed	Monthly	4/year
Extra Heavy	1/day	As needed	Weekly	Monthly

END OF SECTION 096816

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SECTION 097200 - WALL COVERINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Vinyl wall covering
  - 2. Tackable wall surface covering

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 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 Verification: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36-inch- long in size.
  - 1. Wall-Covering Sample: From same production run to be used for the Work, with specified treatments.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For wall coverings to include in maintenance manuals.

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## 1.6 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. Wall-Covering Materials: For each type, color, texture, and finish, full width by length to equal to 5 percent of amount installed.

## 1.7 QUALITY ASSURANCE

- A. Mockups: Build mockups Of tackable wall surfaces 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 F 1141 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.

## 1.8 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 temporary 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.
- 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 according to 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 E 84; 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: 50 or less.

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2.2 VINYL WALL COVERING, WC-1, WC-2, WC-3, WC-4

- A. Manufacturer: Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.
  - 1. Designtex: See Finish Schedule on Drawings for style and color
  - 2. Material 50% Cellulose, 40% Latex, 10% Polyester
  - 3. Backing: None
  - 4. Width: 50"
  - 5. Weight: 18.00 oz per linear yard
  - 6. Hanging information: straight hang, across match
  - 7. Fire rating: Class A, per ASTM E84 (adhered)
  - 8. NFPA 286, meets 2006 IBC Section 803.2.1
  - 9. Flame spread: 10
  - 10. Smoke development: 50
  - 11. Printed with HAP-free inks

2.3 TACKABLE WALL SURFACE COVERING, WC-5

- A. Manufacturers: Basis of Design Product: Subject to compliance with requirements, provide tackboard panel as manufactured by Forbo (basis of design), linoleum tack surface with custom wood frame. See drawings for detail and dimensions. Or comparable product by one of the following:
  - 1. A-1 Visual Systems.
  - 2. Marsh Industries, Inc.; Visual Products Group.
  - 3. PolyVision Corporation; a Steelcase company.
- B. Adhesive: As recommended by manufacturer for substrate.
- C. Linoleum: Comprised from natural materials consisting of linseed oil, cork, rosin binders, and dry pigments mixed and calendared onto a natural jute backing. Unicolor extends throughout the thickness of the product. Material is 1/4" thick, material size see drawings. Make each board from a single piece of material (no splicing).
- D. Color as selected by architect from the manufacturers standard colors.

2.4 ACCESSORIES

- A. Adhesive: Mildew-resistant, nonstaining, strippable 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 099000 "Painting and Coating" 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.

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- D. Manufacturer's standard sealant that matches tackable surface.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, 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, mildew, and incompatible primers.
- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
  - 1. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
  - 2. Painted Surfaces: Treat areas susceptible to pigment bleeding.
- D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.
- E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

#### 3.3 WALL-COVERING INSTALLATION

- 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.

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- D. Install wall covering without lifted or curling edges and without visible shrinkage.
- E. Match pattern 72 inches above the finish floor unless otherwise indicated.
- F. Install seams vertical and plumb at least 6 inches from outside corners and 3 inches from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.
- G. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.
- H. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

#### 3.4 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

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## PART 1 GENERAL

### 1.1 SECTION INCLUDES

- A. Stretched-fabric acoustical wall system and accessories for wall installation.

### 1.2 REFERENCES

- A. Reference Standards: American Society for Testing and Materials (ASTM)

1. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM C423: Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
3. ASTM E795: Standard Practices for Mounting Test Specimens During Sound Absorption Tests

### 1.3 SUBMITTALS

- A. Product Data: Manufacturer's data sheet and installation instructions.

- B. Samples: For the following products, prepared on Samples of size indicated below:

1. Fabric: Full-width by 36-inch- long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
2. Panel Edge: 12-inch-long Sample(s) showing each edge profile, corner, and finish.
3. Core Material: 12-inch-square Sample at corner.
4. Mounting Devices: Full-size Samples.
5. Assembled Panels: Approx. 36 by 36 inches, including joints and mounting methods.

- C. Test Reports: Upon request, submit certified test reports to verify specified product performance.

### 1.4 MAINTENANCE MATERIAL

- A. Extra Materials:

1. Deliver no less than two percent 2% of each type, color and pattern of material.
2. Extra materials shall remain in the manufacturer's original packaging and given to the building owner upon substantial completion of the work. Store extra materials per instructions as described in storage and handling requirements.

### 1.5 INFORMATION SUBMITTALS

- A. Coordination drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated w/ each other, using input from installers of the items involved:



1. Electrical outlets, switches, and thermostats.
2. Items penetrating or covered by fabric-wrapped wall panels including the following:
3. Lighting fixtures.
4. Air outlets and inlets.
5. Speakers.
6. Alarms.
7. Sprinklers.
8. Access panels.
9. Show operation of hinged and sliding components covered by or adjacent to fabric-wrapped wall panels.

## 1.6 QUALITY ASSURANCE

### A. Qualifications:

1. Manufacturers: Provide acoustical wall system from a single manufacturer.
2. Installers: Utilize an installer having demonstrated experience on projects of comparable size and complexity.

### B. Performance Requirements:

1. Surface Burning Characteristics: Acoustical wall system to perform as specified when tested in accordance with ASTM E84. Acoustical wall system burning performance should comply with the International Building Code and other local building code requirements.
2. Acoustical Characteristics: Acoustical wall system to perform as specified when tested in accordance with ASTM C423.

## 1.7 DELIVERY, STORAGE, AND HANDLING

### A. Storage and Handling Requirements:

1. Handle acoustical wall system components carefully to avoid any damage.
2. Store acoustical wall system components indoors in a clean, cool, dry place, and out of direct sunlight.
3. Store acoustical wall system components in a space where the ambient temperature and humidity conditions are being maintained at the levels indicated for the project when occupied for its intended use.

## 1.8 SITE CONDITIONS

### A. Ambient Conditions:

1. Maintain ambient temperature and humidity conditions at levels indicated for the project when occupied for its intended use.

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2. Do not install acoustical wall system under environmental conditions outside manufacturer's recommended limits.
- B. Existing Conditions: Do not install acoustical wall system until space is enclosed and weather proofed, and wet work is completely dry.

## 1.9 WARRANTY

- A. Provide manufacturer's written product warranty per Section 01 77 00 – Closeout Procedures.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis of Design: Acoustical Surfaces, Inc

### 2.2 DESCRIPTION

- A. Basis of Design Product: Wallmate® stretched-fabric acoustical wall system by Acoustical Surfaces, Inc.
- B. Product Options:
  1. System Description: Stretched-fabric system over acoustical backer
  2. Thickness: 1"
  3. Size: 84" Lengths
  4. Edge Detail: Square
  5. Finish: Guilford of Maine Acoustical Fabric as indicated on Finish Schedule and Equipment Schedule on Drawings
  6. Mounting Method: Direct Attach
- C. Product Performance:

1. Acoustical Performance

- a. Noise Reduction Coefficient (NRC) per ASTM C423:

Backer	NRC Rating
1" 3lb Echo Eliminator	0.80

2. Surface Burning Performance

- a. Fire Rating per ASTM E84: Class A.

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## 2.3    ACCESSORIES

- A. Attachment hardware for acoustical wall system as specified by manufacturer for installation.
- B. Accessories with Options:
  - 1. Acoustical backer:    1" Echo Eliminator

## PART 3 EXECUTION

### 3.1    EXAMINATION

- A. Verification of Conditions:
  - 1. Examine surfaces scheduled to receive furred out or directly attached acoustical wall system for unevenness, irregularities or dampness that would affect quality and execution of work.
  - 2. All wet work in installation area must be complete, cured, and dry prior to installation.
  - 3. Wall assembly shall be complete, inspected, and accepted before wall work begins.

### 3.2    INSTALLATION

- A. Comply with manufacturer's instructions and recommendations for installation of acoustical wall system and with industry standards.

### 3.3    CLEANING

- A. Clean surfaces of acoustical wall system per manufacturer's instructions or recommendations.
- B. Remove and replace damaged or discolored material and material that cannot be properly cleaned.

### 3.4    PROTECTION

- A. Protect installed work from damage due to subsequent construction activity, including temperature and humidity limitations and dust control, so that the work will be without damage and deterioration at the time of acceptance by the owner.

END OF SECTION

SECTION 097733 - FIBERGLASS REINFORCED PLASTIC PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes
  - 1. Surface preparation and prime painting.
  - 2. Sanitary wall panels.

1.2 SUBMITTALS

- A. Shop Drawings: Indicate wall elevations with joint layout.
- B. Product Data: Provide data on panels and adhesive.
- C. Samples:
  - 1. Submit two samples of panels 3 x 3 inch in size illustrating color, finish, and texture.
  - 2. Submit two samples of each type trim and moldings 12 inches long illustrating color, finish, and texture.
- D. Test Reports: Indicate verification of flame and smoke ratings, when tested by UL.
- E. Manufacturer's Installation Instructions: Submit special procedures and perimeter conditions requiring special attention.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair of covered surfaces.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of three years documented experience.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature range of 65 - 85 degrees F.
- B. Do not apply materials when relative humidity is greater the 80 percent.

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- C. Maintain these conditions 48 hours before, during and after installation of panels.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed ratings when tested to ASTM E84.

### 2.2 MATERIALS - FIBERGLASS, FRP-1

- A. Subject to requirements, provide products indicated in Finish Schedule on Drawings as Basis of Design.
- B. Manufacturers:
  - 1. Nudo Products, Inc.
  - 2. Marlite
  - 3. Crane Composites Inc.
- C. Sanitary Panels: Rigid, impact resistant fiberglass panels, 0.090 inches thick, color and texture as selected, 48 inches wide.
- D. Adhesive: Type Silicone as specified in Section 079000 "Joint Sealants".
- E. Substrate Filler: Recommended by adhesive and panel manufacturers compatible with substrate.
- F. Substrate Primer: As specified in Section 099000.
- G. Trim: Manufacturer's standard single piece, color to match sanitary panels:
  - 1. Panel Joints: Joint strip molding.
  - 2. Corners: Inside and outside corner angles.
  - 3. Termination Trim: J-molding.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that substrate surfaces are flat and prime painted, ready to receive work.
- B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply panels unless moisture content of surfaces are below the following maximums:

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3.2 PREPARATION

- A. Fill cracks and smooth irregularities with filler, sand smooth. Vacuum clean surfaces.
- B. Surface Appurtenances: Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

3.3 INSTALLATION

- A. Apply adhesive and panels in accordance with manufacturer's instructions.
- B. Apply adhesive and panels smooth. Ensure full bond to substrate surface.
- C. Horizontal joints on walls are not acceptable.
- D. Joints are not permitted within 12 inches of corners and terminations.
- E. Install termination trim.
- F. Remove excess adhesive.
- G. Seal joints with adjacent materials with sanitary silicone sealant as specified in Section 079000.

3.4 CLEANING

- A. Clean panels of excess adhesive, dust, dirt, and other contaminants.
- B. Reinstall wall plates and accessories removed prior to work of this section.

END OF SECTION

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SECTION 09 84 33 - SOUND-ABSORBING WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sound-absorbing wall panels, custom-fabricated and fabric-finished.

1.02 REFERENCES

- A. ASTM International
  - 1. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
  - 2. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 3. ASTM E795 Standard Practices for Mounting Test Specimens During Sound Absorption Tests.

1.03 SYSTEM DESCRIPTION

- A. Performance Requirements:
  - 1. Surface Burning Characteristics (ASTM E84):
    - a. Flamespread: 25 maximum.
    - b. Smoke Developed: 450 maximum.
    - c. Fire ratings for all fabric covered panels is based on testing of the panel wrapped with the standard in stock fabric, Guilford of Maine, Model FR 701.

1.04 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
- B. Product Data: Submit product data sheet, for specified products.
- C. Shop Drawings: Submit shop drawings showing layout, edge profiles and panel components, including anchorage, accessories, finish colors and textures.
- D. Samples: Submit selection and verification samples of finishes, colors and textures.
- E. Test Reports: Certified test reports showing compliance with specified performance requirements.
  - 1. Standard Systems: Submit certified copies of previous test reports substantiating performance of system in lieu of retesting.

1.05 DELIVERY, STORAGE, AND HANDLING

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- A. General: Comply with Division 1 Product Requirements Section.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

#### 1.06 PROJECT CONDITIONS

- A. Environmental Requirements: Do not install panels until wet work, such as concrete and plastering, is complete; the building is enclosed; and the temperature and relative humidity are stabilized at 60 - 80 degrees F (16 - 27 degrees C) and 35% MINIMUM RH and 55% MAXIMUM RH, respectively. All products constructed with wood or wood fiber content must be stored for at least 72 hours in the controlled environment specified herein prior to installation to allow the materials to stabilize.

### PART 2 PRODUCTS

#### 2.01 SOUND-ABSORBING WALL PANELS

- A. Manufacturer: Kinetics Noise Control, Inc.
  - 1. Contact: PO Box 655, 6300 Irelan Place, Dublin, OH 43017; Telephone: (614) 889-0480; Fax: (614) 889-0540; E-mail: [intsales@kineticsnoise.com](mailto:intsales@kineticsnoise.com); Web site: [www.kineticsnoise.com](http://www.kineticsnoise.com).
- B. Substitutions: No substitutions permitted.

#### 2.02 MANUFACTURED UNITS

- A. SportsBoard Elite Fabric-Wrapped Copolymer Panels:
  - 1. Thickness: [1-1/16 inches (27 mm)] [2-1/16 inches (52 mm)].
  - 2. Size: As indicated on the drawings up to a maximum 48 inches (1219 mm) x 120 inches (3048 mm).
  - 3. Core: [1 inch (25.4 mm) thick] [2 inches (51 mm) thick], 6 - 7 pcf (96 - 112 kg/m<sup>3</sup>) density fiberglass.
  - 4. Edge Detail: [Square] hardened with a Class A hardening solution.
  - 5. Fabric Facing: [100% polyester fabric, FR 701 Style 2100 by Guilford of Maine] [Factory approved customer selected fabric]. Designer selected fabrics must be approved by the panel manufacturer as acceptable quality for wrapping and covering core materials. Some fabrics are unstable, too stiff, or lack the weight and thread density for producing an acceptable finish.
    - a. Color: Refer to Finish Schedule on Drawings
  - 6. Copolymer Impact Resistant Layer: 1/16 inch (1.6 mm) thick copolymer perforated with 3/32 inch (2.4 mm) holes on 5/32 inch (4 mm) staggered centers.
  - 7. Sound Absorption (ASTM C423, A Mounting): Noise Reduction Coefficient of [0.85, 1 inch thick core] [1.00, 2 inch thick core] minimum.



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8. Mounting Accessories: [HS impaling clips] [Z-clips] [Velcro] [Rotofast Snap-On].

## 2.03 FABRICATION

### A. SportsBoard Elite Panels

1. Wrap panel edges and return facing fabric 1 to 2 inches (25.4 to 51 mm) on back of panel. Secure fabric with adhesive applied to edges and back of panel only.

## PART 3 EXECUTION

### 3.01 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.

### 3.02 EXAMINATION

- A. Site Verification of Conditions: Verify that substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.
  1. Verify that stud spacing is 16 inches (406 mm) o.c., maximum, for panels installed over open studs.
  2. Do not install panels until unsatisfactory conditions are corrected.

### 3.03 CLEANING

- A. Follow manufacturer's instructions for cleaning panels soiled during installation. Replace panels that cannot be cleaned to as new condition.
- B. Keep site free from accumulation of waste and debris.

END OF SECTION

SECTION 098436 - SOUND-ABSORBING CEILING UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes shop-fabricated, fabric-wrapped panel units tested for acoustical performance, including:
  - 1. Sound-absorbing baffle panels.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, mounting, material descriptions, dimensions of individual components and profiles, and finishes for sound-absorbing ceiling units.
  - 2. Include furnished specialties and accessories.
- B. Shop Drawings: For sound-absorbing ceiling units.
  - 1. Include plans, elevations, sections, and mounting devices and details.
  - 2. Include details at joints and corners; and details at ceiling intersections and intersections with walls. Indicate panel edge and core materials.
  - 3. Include reflected ceiling plans showing panel sizes and direction of fabric weave and pattern matching.
- C. Samples for Verification: For the following products:
  - 1. Fabric: Full-width by approximately 36-inch- long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
  - 2. Panel Edge: 12-inch- long Sample(s) showing each edge profile, corner, and finish.
  - 3. Core Material: 12-inch- square Sample at corner.
  - 4. Mounting Devices: Full-size Samples.
  - 5. Assembled Panels: Approximately 36 by 36 inches, including joints and mounting methods.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling 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. Electrical outlets, switches, and thermostats.
2. Suspended ceiling components above sound-absorbing ceiling units.
3. Structural members to which suspension devices will be attached.
4. Items penetrating or covered by sound-absorbing ceiling units including the following:
  - a. Lighting fixtures.
  - b. Air outlets and inlets.
  - c. Speakers.
  - d. Alarms.
  - e. Sprinklers.
  - f. Access panels.
5. Show operation of hinged and sliding components covered by or adjacent to sound-absorbing ceiling units.

B. Product Certificates: For each type of sound-absorbing ceiling unit.

C. Sample Warranty: For special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sound-absorbing ceiling units to include in maintenance manuals. Include fabric manufacturer's written cleaning and stain-removal recommendations.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and sound-absorbing ceiling unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

#### 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install sound-absorbing ceiling 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.
- B. Lighting: Do not install sound-absorbing ceiling units until a permanent level of lighting is provided on surfaces to receive the units.
- C. Air-Quality Limitations: Protect sound-absorbing ceiling units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.

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- D. Field Measurements: Verify locations of sound-absorbing ceiling units and actual dimensions of openings and penetrations by field measurements before fabrication.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of sound-absorbing ceiling units that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Acoustical performance.
    - b. Fabric sagging, distorting, or releasing from panel edge.
    - c. Warping of core.
  - 2. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Product:
  - 1. Baffles: Subject to compliance with requirements, provide Armstrong Soundscapes Blades or and approved comparable product
  - 2. Suspension System: Subject to compliance with requirements, provide Armstrong Soundscapes Blades or and approved comparable product
- B. Sound-Absorbing Baffle Panel: Manufacturer's standard panel construction.
  - 1. Mounting: Aircraft Cable: Acceptable product as manufactured by Armstrong World Industries Item 6655L8CR - 4-Point Hanging Kit (4 per bag)
  - 2. Panel Thickness: 1-3/4 inch.
  - 3. Core: Manufacturer's standard.
  - 4. Core-Face Layer: Manufacturer's standard tackable, impact-resistant, high-density board.
  - 5. Sizes:
    - a. 10 x 46 x 1-3/4" Rectangle (item 8250F03RH01)
    - b. 10 x 94 x 1-3/4" Rectangle (item 8250F03RH02)
  - 6. Edges: Square
  - 7. Fabric: As indicated on Finish Schedule on Drawings
  - 8. Acoustical Performance: Sound absorption NRC of 1.80 according to ASTM C 423.
- C. Source Limitations: Obtain sound-absorbing ceiling units from single source from single manufacturer

### 2.2 PERFORMANCE REQUIREMENTS

- A. General Requirements for Sound-Absorbing Ceiling Units: Provide and sound-absorbing baffle 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."

- B. Fire-Test-Response Characteristics: Provide sound-absorbing ceiling units meeting the following requirements as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. Surface-Burning Characteristics: Comply with ASTM E 84; 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.
- C. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265.

## 2.3 FABRICATION

- A. General: Use manufacturer's standard construction except as otherwise indicated, with facing material applied to face, edges, and back border of dimensionally stable core and with rigid edges to reinforce panel perimeter against warpage and damage.
- B. Core-Face Layer: Evenly stretched over core face and edges and securely attached to core; free from puckers, ripples, wrinkles, or sags.
- C. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.
  - 1. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches adjacent units.
- D. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting performance of sound-absorbing ceiling units.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

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### 3.2 INSTALLATION

- A. Install sound-absorbing ceiling units in locations indicated with edges in alignment with walls and other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with sound-absorbing ceiling unit manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.
- C. Align fabric pattern and grain with adjacent units.

### 3.3 INSTALLATION TOLERANCES

- A. Variation from Alignment with Surfaces: Plus or minus 1/16 inch.
- B. Variation from Level or Slope: Plus or minus 1/16 inch.

### 3.4 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION

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SECTION 099000 - PAINTING AND COATING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following substrates:
  - 1. Concrete.
  - 2. Fiber-cement board.
  - 3. Concrete masonry units (CMUs).
  - 4. Steel and iron.
  - 5. Galvanized metal.
  - 6. Aluminum (not anodized or otherwise coated).
  - 7. Stainless steel.
  - 8. Wood.
  - 9. Fiberglass.
  - 10. Plastic.
  - 11. Gypsum board.
  - 12. Acoustic panels and tiles.
  - 13. ASJ insulation covering.
  - 14. Bituminous-coated surfaces.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and for each color and gloss of topcoat.
  - 1. Submit Samples on rigid backing, 8 inches square.
  - 2. Apply coats on Samples in steps to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For paint and coating products to include in Project maintenance manuals.
  - 1. Include summary description with finish schedule indicating area name, substrate, finish product, and color for each Project area.

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2. Include detail description indicating specific product, color, finish, purchase location, and physical color sample for each Project area.
3. Include maintenance instructions for care and cleaning and touchup.
4. Include product data sheets and Material Safety Data Sheets for each product used on Project.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, as installed products.
  1. Package products with protective covering for storage and identified with labels describing contents.
  2. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

#### 1.5 QUALITY ASSURANCE

- A. Mockups: Apply mockups 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. Architect will select one surface to represent surfaces and conditions for application of each paint system.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
    - b. Other Items: Architect will designate items or areas required.
  2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
  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.

#### 1.6 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.
  1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.

#### 1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.



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- C. Do not apply exterior paints 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. Sherwin Williams as basis of design.
  - 2. Benjamin Moore.
  - 3. Behr Process Corporation.
  - 4. PPG Paints.
  - 5. Tnemec.
- B. Products: Provide products scheduled in this Section.

### 2.2 PAINT, GENERAL

- A. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.
- B. Colors: See Finish Schedule on Drawings.

### 2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
  - 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint 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 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.

## 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.

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- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Concrete: 12 percent.
  - 2. Fiber-Cement Board: 12 percent.
  - 3. Masonry (Clay and CMUs): 12 percent.
  - 4. Wood: 15 percent.
  - 5. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces 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 hardware, covers, plates, and similar items already in place that are removable and 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.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer. Clean using methods recommended in writing by paint manufacturer but not less than the following:
  - 1. SSPC-SP 2.
  - 2. SSPC-SP 3.
  - 3. SSPC-SP 11.

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- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. 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.
- K. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

### 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, 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 both sides and edges of exterior doors and entire exposed surface of exterior door frames.
  - 4. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- 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.

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- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
  - 1. Paint the following work where exposed in equipment rooms:
    - a. Equipment, including panelboards.
    - b. Uninsulated metal piping.
    - c. Uninsulated plastic piping.
    - d. Pipe hangers and supports.
    - e. Metal conduit.
    - f. Plastic conduit.
    - g. Tanks that do not have factory-applied final finishes.
    - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
  - 2. Paint the following work where exposed in occupied spaces:
    - a. Equipment, including panelboards.
    - b. Uninsulated metal piping.
    - c. Uninsulated plastic piping.
    - d. Pipe hangers and supports.
    - e. Metal conduit.
    - f. Plastic conduit.
    - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    - h. Other items as directed by Architect.
  - 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

### 3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
  - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
  - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

### 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 Architect, and leave in an undamaged condition.

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- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.6 SCHEDULE - EXTERIOR SURFACES - LATEX

A. Shop Primed Ferrous Metal - Gloss Acrylic Enamel:

1. Benjamin Moore:
  - a. Finish: Two coats DTM M-28 Acrylic Gloss, 2.0 mils dry film thickness each coat.
2. Behr:
  - a. Finish: Two coats Direct-To-Metal Gloss 8200 1.7 mils dry film thickness each coat.
3. PPG Paints:
  - a. Finish: Two coats 90-374 Pitt-Tech DTM Acrylic Gloss, 2 - 3 mils dry film thickness each coat.
4. Sherwin-Williams:
  - a. Finish: Two coats DTM Acrylic Gloss B66, 2.5 - 4.0 mils dry film thickness each coat.

B. Ferrous Metal - Gloss Acrylic Enamel:

1. Benjamin Moore:
  - a. Primer: One coat M-28 Acrylic Metal Primer; 2.0 mils dry film thickness.
  - b. Finish: Two coats M-28 Acrylic Gloss Enamel; 2.0 mils dry film thickness each coat.
2. Behr:
  - a. Primer: One coat Premium Plus Multi-Surface Primer 436. 1.7 - 2.7 mils dry film thickness.
  - b. Finish: Two coats Direct-To-Metal Gloss 8200, 1.7 mils dry film thickness each coat.
3. PPG Paints:
  - a. Primer: One coat 90-712 Pitt-Tech DTM Acrylic Primer/Finish, 2 - 3 mils dry film thickness.
  - b. Finish: Finish: Two coats Pitt-Tech DTM Acrylic Gloss, 2 - 3 mils dry film thickness each coat.
4. Sherwin-Williams:
  - a. Primer: One coat DTM Acrylic Primer/Finish B66W1, 2.5 - 5.0 mils dry film thickness.
  - b. Finish: Finish: Two coats DTM Acrylic Gloss B66, 2.5 - 4.0 mils dry film thickness each coat.

C. Galvanized Metals - Gloss Acrylic Enamel: Pretreat as required by manufacturer.

1. Benjamin Moore:
  - a. Primer: One coat M-28 Acrylic Metal Primer; 2.0 mils dry film thickness
  - b. Finish: Two coats M-28 Acrylic Gloss Enamel; 2.0 mils dry film thickness each coat.
2. Behr:
  - a. Primer: One coat Premium Plus Multi-Surface Primer 436. 1.7 - 2.7 mils dry film thickness.

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- b. Finish: Two coats Direct-To-Metal Gloss 8200, 1.7 mils dry film thickness each coat.
    - 3. PPG Paints:
      - a. Primer: One coat 90-712 Pitt-Tech DTM Acrylic Primer/Finish, 2 - 3 mils dry film thickness.
      - b. Finish: Two coats 90-374 Pitt-Tech DTM Acrylic Gloss, 2 - 3 mils dry film thickness each coat.
    - 4. Sherwin-Williams:
      - a. Primer: One coat DTM Acrylic Primer/Finish B66W1, 2.5 - 5.0 mils dry film thickness.
      - b. Finish: Two coats DTM Acrylic Gloss B66, 2.5 - 4.0 mils dry film thickness each coat.
- D. Wood and Plastic, New - High Gloss Latex Enamel:
  - 1. Benjamin Moore:
    - a. Primer: One coat Fresh Start Exterior Primer 023; 1.8 mils dry film thickness.
    - b. Finish: Two coats DTM Acrylic M28; 2.0 mils dry film thickness each coat.
  - 2. Behr:
    - a. Primer: One coat Premium Plus Multi-Surface Primer 436. 1.7 - 2.7 mils dry film thickness.
    - b. Finish: Two coats Premium Plus Hi-Gloss 8050. 1.4 - 2.2 mils dry film thickness each coat.
  - 3. PPG Paints:
    - a. Primer: One coat Seal Grip 17-921 Acrylic Primer, 1.5 dry film thickness
    - b. Finish: Two coats 90-374 Pitt-Tech DTM Acrylic Gloss, 2 - 3 mils dry film thickness each coat.
  - 4. Sherwin-Williams:
    - a. Primer (Wood): One coat Exterior Oil Based Wood Primer, Y24W820, 1.5 mils dry film thickness.
    - b. PVC Plastic Primer: One coat Multi Purpose Latex Primer, B51-800; 1.5/2 mils dry film thickness.
    - c. Finish: Two coats DTM Acrylic B66-100, 2.0 mils dry film thickness each coat.
- E. Concrete and Concrete Masonry Units - Semi-Gloss Acrylic:
  - 1. Benjamin Moore: Concrete
    - a. Primer: One coat Acrylic Masonry Sealer 066; dry film thickness as recommended by manufacturer.
    - b. Finish: Two coats Super Spec Latex House and Trim Paint 170; 1.1 mils dry film thickness each coat.
  - 2. Benjamin Moore: Concrete Masonry Units
    - a. Primer: One coat Super Craft Latex Block Filler 285; 8.1 mils dry film thickness.
    - b. Finish: Two coats Super Spec Latex House and Trim Paint 170; 1.1 mils dry film thickness each coat.
  - 3. Behr:
    - a. Primer: One coat Premium Plus Multi-Surface Primer 436. 1.7 - 2.7 mils dry film thickness.
    - b. Finish: Two coats Behr Pro e600 Semi-Gloss 670. 1.3 - 2.0 mils dry film thickness each coat.

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4. PPG Paints:
    - a. Primer: One coat 6-15 Speedhide Acrylic Masonry Block Filler, 5 - 14 mils dry film thickness.
    - b. Finish: Two coats PP649 Acri-Shield Semi-Gloss Acrylic, 1.5 mils dry film thickness each coat.
  5. Sherwin-Williams:
    - a. Filler: One coat Loxon Block Surfacers, A24W200 as recommended by S-W.
    - b. Finish: Two coats A-100 Gloss Latex House & Trim A8, 1.5 mils dry film thickness each coat.
- F. Concrete - Elastomeric fine texture:
1. Benjamin Moore:
    - a. Primer: One coat Acrylic Masonry Sealer 066; dry film thickness as recommended by manufacturer.
    - b. Finish: Two coats Moorlastic Acrylic Elastomeric Waterproof Coating 056; 3.9 mils dry film thickness each coat.
  2. Behr:
    - a. Primer: One coat Premium Plus Multi-Surface Primer 436. 1.7 - 2.7 mils dry film thickness.
    - b. Finish: Two coats Premium Elastomeric Paint 68. 6.1 - 10.2 mils dry film thickness each coat
  3. PPG Paints:
    - a. Primer: One coat 4-2 Perma-Crete High Build Acrylic Primer, 2.6 – 3.2 mils dry film thickness.
    - b. Finish: Two coats 4-110 Perma-Crete Pitt-Flex Elastomeric Smooth Texture, 5.4 – 7.2 mils dry film thickness each coat.
  4. Sherwin-Williams:
    - a. Primer: One coat Loxon Concrete and Masonry Primer A24W8300, 3.1 mils dry film thickness.
    - b. Finish: Two coats Con-Flex XL Textured High Build Coating, A5-800 Series; 9-11 mils dry film thickness each coat.

### 3.7 SCHEDULE - INTERIOR SURFACES - LATEX

- A. Shop Primed Ferrous Metal - Semi-Gloss Latex:
1. Benjamin Moore:
    - a. Finish: Two coats Super Spec Latex Semi-Gloss Enamel 276, 1.2 mils dry film thickness each coat.
  2. Behr:
    - a. Finish: Two coats Behr Pro i300 Interior Semi-Gloss, 370, 1.7 mils dry film thickness each coat.
  3. PPG Paints:
    - a. Finish: Two coats PPG Speedhide Interior Semi-Gloss Acrylic Latex, 6-500 Series, 1.4 mils dry film thickness.
  4. Sherwin-Williams:
    - a. Finish: Two coats Promar 200 Zero VOC Interior Latex Semi-Gloss, B31-2600, 1.7 mils dry film thickness each coat.

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B. Ferrous Metal - Semi-Gloss Latex:

1. Benjamin Moore:
  - a. Primer: One coat M 04 Acrylic Metal Primer; 2.0 mils dry film thickness.
  - b. Finish: Two coats Super Spec Latex Semi-Gloss Enamel 276; 1.2 mils dry film thickness each coat.
2. Behr:
  - a. Primer: One coat Premium Plus Multi-Surface Primer 436. 1.7 - 2.7 mils dry film thickness.
  - b. Finish: Two coats BehrPro i300 Interior Semi-Gloss, 370, 1.7 mils dry film thickness each coat.
3. PPG Paints:
  - a. Primer: One coat 90-712 Pitt-Tech Int/Ext Industrial DTM Primer/Finish, 2 - 3 mils dry film thickness.
  - b. Finish: Two coats PPG Speedhide Interior Semi-Gloss Acrylic Latex 6-500 Series 1.4 mils dry film thickness.
4. Sherwin-Williams:
  - a. Primer: One coat DTM Acrylic B66 Primer/Finish B66W1, 2.5 - 5.0 mils dry film thickness.
  - b. Finish: Two coats Promar 200 Zero VOC Interior Latex Semi-Gloss, B31-2600, 1.5 mils dry film thickness each coat.

C. Galvanized Metals - Semi-Gloss Latex: Pretreat as required by manufacturer.

1. Benjamin Moore:
  - a. Primer: One coat M 04 Acrylic Metal Primer; 2.0 mils dry film thickness.
  - b. Finish: Two coats Super Spec Semi-Gloss Enamel 276; 1.2 mils dry film thickness each coat.
2. Behr:
  - a. Primer: One coat Premium Plus Multi-Surface Primer 436. 1.7 - 2.7 mils dry film thickness.
  - b. Finish: Two coats BehrPro i300 Interior Semi-Gloss, 370, 1.7 mils dry film thickness each coat.
3. PPG Paints:
  - a. Primer: One coat 90-712 Pitt-Tech Int/Ext Industrial DTM Primer/Finish Enamel, 2 - 3 mils dry film thickness.
  - b. Finish: Two coats PPG Speedhide Interior Semi-Gloss Acrylic Latex, 6-500 Series, 1.4 mils dry film thickness.
4. Sherwin-Williams:
  - a. Primer: One coat DTM Acrylic B66 Primer/Finish B66W1, 2.5 - 5.0 mils dry film thickness.
  - b. Finish: Finish: Two coats ProMar 200 Zero VOC Interior Latex Semi-Gloss, B31-2600 1.5 mils dry film thickness each coat.

D. Insulated Coverings - Flat Latex:

1. Benjamin Moore:
  - a. Primer: One coat Super Spec Latex Enamel Undercoater and Primer Sealer 253; 1.2 mils dry film thickness.
  - b. Finish: Two coats Super Spec Latex Flat 275; 1.2 mils dry film thickness each coat.
2. Behr:



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- a. Primer: One coat Premium Interior Drywall Primer & Sealer 73. 1.0 mils dry film thickness.
- b. Finish: Two coats BehrPro i300 Interior Flat, 310, 1.7 mils dry film thickness each coat.
3. PPG Paints:
  - a. Primer: PPG Speedhide Interior Latex Primer Sealer 6-2, 1.0 mils dry film thickness.
  - b. Finish: Two coats PPG Speedhide Interior Flat 6-70 Series, 1.3 mils dry film thickness each coat.
4. Sherwin-Williams:
  - a. Primer: One coat Premium Wall & Wood Primer, B28W08111, 1.6 mils dry film thickness.
  - b. Finish: Two coats ProMar 200 Zero VOC Interior Latex Flat Wall Paint B30-2600, 1.6 mils dry film thickness each coat.

3.8 SCHEDULE - INTERIOR SURFACES - LATEX, LOW VOC

A. Concrete Masonry Units – Semi-Gloss Finish

1. Benjamin Moore:
  - a. Filler Coat: MoorCraft Int/Ext Block Filler 285.
  - b. Finish: Two Coats Pristine Latex Semi-Gloss 214.
2. Behr:
  - a. Filler Coat: Behr Pro Block Filler Primer 50.
  - b. Finish: Two coats Behr Pro i300 Interior Semi-Gloss 370.
3. PPG Paints:
  - a. Filler Coat: Speedhide Block Filler 6-15
  - b. Finish: Two coats Pure Performance Semi-Gloss 9-500
4. Sherwin Williams:
  - a. Filler Coat: Loxon Block Surfacers, A24W200.
  - b. Finish: Two coats ProMar 200 Zero VOC Interior Latex Semi-Gloss B31-2600.

B. Gypsum Board: Flat Finish:

1. Benjamin Moore:
  - a. Primer: One coat Pristine Eco Spec Latex Primer Sealer 231.
  - b. Finish: Two Coats Pristine Eco Spec Latex Flat 219.
2. Behr:
  - a. Primer: Premium Plus Interior Drywall Primer & Sealer 73
  - b. Finish: Two coats Behr Pro i300 Interior Flat 310.
3. PPG Paints:
  - a. Primer: One coat Pure Performance Primer 9-900
  - b. Finish: Two coats Pure Performance Flat 9-100
4. Sherwin Williams:
  - a. Primer: One coat Premium Wall & Wood Primer, B28W08111 Series.
  - b. Finish: Two coats ProMar 200 Zero VOC Interior Latex Flat B30W0265.

C. Gypsum Board: Eggshell Finish:

1. Benjamin Moore:
  - a. Primer: One coat Pristine Eco Spec Latex Primer Sealer 231.

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- b. Finish: Two Coats Pristine Eco Spec Latex Eggshell 223.
  2. Behr:
    - a. Primer: Premium Plus Interior Drywall Primer & Sealer 73
    - b. Finish: Two coats Behr Pro i300 Interior Eggshell 330.
  3. Dunn Edwards:
    - a. Primer: One coat Acri-loc W6232 Acrylic Masonry Primer.
    - b. Finish: Two coats Spartashell W7400 Acrylic Eggshell.
  4. Frazee Paint:
    - a. Primer: One coat 066 Envirokote Primer
    - b. Finish: Two coats 029 Envirokote Eggshell.
  5. PPG Paints:
    - a. Primer: One coat Pure Performance Primer 9-900
    - b. Finish: Two coats Pure Performance Eggshell 9-300
  6. Sherwin Williams:
    - a. Primer: One coat Premium Wall & Wood Primer, B28W08111 Series.
    - b. Finish: Two coats ProMar 200 Zero VOC Interior Latex Eg-shel B20-2600.
- D. Gypsum Board: Semi-Gloss Finish:
  1. Benjamin Moore:
    - a. Primer: One coat Pristine Eco Spec Latex Primer Sealer 231.
    - b. Finish: Two Coats Pristine Eco Spec Latex Semi-Gloss 224.
  2. Behr:
    - a. Primer: Premium Plus Interior All-In-One Primer & Sealer 75.
    - b. Finish: Two coats Behr Pro i300 Interior Semi-Gloss 370.
  3. PPG Paints:
    - a. Primer: One coat Pure Performance Primer 9-900
    - b. Finish: Two coats Pure Performance Semi-Gloss 9-500
  4. Sherwin Williams:
    - a. Primer: One coat Premium Wall & Wood Primer, B28W08111 Series.
    - b. Finish: Two coats ProMar 200 Zero VOC Interior Latex Semi-Gloss B31W0265.
- E. Wood: Semi-Gloss Finish:
  1. Benjamin Moore:
    - a. Primer: One coat Pristine Eco Spec Latex Primer Sealer 231.
    - b. Finish: Two Coats Pristine Eco Spec Latex Semi-Gloss 224.
  2. Behr:
    - a. Primer: Premium Plus Interior All-In-One Primer & Sealer 75.
    - b. Finish: Two coats Behr Pro i300 Interior Semi-Gloss 370.
  3. PPG Paints:
    - a. Primer: One coat Pure Performance Primer 9-900
    - b. Finish: Two coats Pure Performance Semi-Gloss 9-500
  4. Sherwin Williams:
    - a. Primer: One coat Premium Wall & Wood Primer, B28W8111.
    - b. Finish: Two coats ProMar 200 Zero VOC Interior Latex Semi-Gloss B31-2600.
- F. Ferrous Metal: Semi-Gloss Finish:
  1. Benjamin Moore:
    - a. Primer: One coat IronClad Latex Low Lustre Metal and Wood Enamel 363.

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- b. Finish: Two Coats Pristine Eco Spec Latex Semi-Gloss 224.
- 2. PPG Paints:
  - a. Primer: One coat Pitt-Tech DTM Acrylic Primer 90-712
  - b. Finish: Two coats Pure Performance Semi-Gloss 9-500
- 3. Sherwin Williams: For doors and door frames.
  - a. Primer: One coat ProIndustrial Pro-Cryl Universal WB Primer, B66-310.
  - b. Finish: Two coats ProIndustrial High Performance Acrylic Semi-Gloss B66-650 series.
- 4. Behr: For doors and door frames.
  - a. Primer: One coat Premium Plus Multi-Surface Primer & Sealer 436.
  - b. Finish: Two coats; Premium Direct-To-Metal Semi-Gloss 3200.
- 5. Sherwin Williams: For other ferrous metals.
  - a. Primer: One coat Pro Industrial Pro Cryl Universal WB Primer, B666-310.
  - b. Finish: Two coats ProMar 200 Zero VOC Interior Latex Semi-Gloss B31-2600 series.
- 6. Behr: For other ferrous metals.
  - a. Primer: One coat Premium Plus Multi-Surface Primer & Sealer 436.
  - b. Finish: Two coats; Behr Pro i300 Interior Semi-Gloss 370.

END OF SECTION

SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Primers
2. Wood stains.
3. Transparent finishes.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
2. Include preparation requirements and application instructions.
3. Indicate VOC content.

B. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

C. Samples for Verification: Sample for each type of finish system and in each color and gloss of finish required on representative samples of actual wood substrates.

1. Size: 12 inches square.
2. Apply coats on Samples in steps 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: Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials 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.

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#### 1.4 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.

#### 1.5 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 of 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. Sherwin Williams
- B. Benjamin Moore
- C. Pratt & Lambert
- D. Pre-approved equal

#### 2.2 SOURCE LIMITATIONS

- A. Source Limitations: Obtain each coating product from single source from single manufacturer.

#### 2.3 MATERIALS, GENERAL

- A. Material Compatibility:
  - 1. Provide materials for use within each coating 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.
- B. Stain Colors: As selected by Architect from manufacturer's full range.

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## 2.4 TRANSPARENT FINISHES

- A. Varnish, Exterior, Water Based, Semigloss: Water-based clear varnish for exterior wood surfaces. Only use a clear primer if recommended by the varnish manufacturer and will leave the wood with a clear finish.
  - 1. PPG
  - 2. Sherwin Williams
  - 3. Gloss Level: Manufacturer's standard semigloss finish.

## 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 Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.
- C. Maximum Moisture Content of Interior Wood Substrates: 10 percent, when measured with an electronic moisture meter.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. 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. 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.
- B. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each 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.

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2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

C. Exterior Wood Substrates: Only use a primer if product is specified in this section

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Prime edges, ends, faces, undersides, and backsides of wood.
  - a. For solid hide stained wood, stain edges and ends after priming.
  - b. For varnish-coated stained wood, stain edges and ends and prime with varnish. Prime undersides and backsides with varnish.
3. Countersink steel nails, if used, and fill with putty or plastic wood filler tinted to final color. Sand smooth when dried.

D. Interior Wood Substrates: Only use a primer if product is specified in this section

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Apply wood filler paste to open-grain woods to produce smooth, glasslike finish.
3. Sand surfaces 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 dry.

### 3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions.

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.

C. Lightly sand between coats.

### 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.

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- 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.

END OF SECTION



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SECTION 099600 – EXTERIOR TEXTURED COATINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, and Division-1 Specification sections.

1.02 DESCRIPTION OF WORK

A. Types of special coatings include, but are not necessarily limited to, the following:

1. Concrete Coating System

1.03 RELATED WORK

A. Concrete Surfaces (Tilt-up, Pre-cast and Cast-In-Place)

1.04 SYSTEM DESCRIPTION

A. Concrete Coating System:

1. TEX•COTE® XL-70 “W” Textured Coating: A high build, plasticized, epoxy acrylate, acrylic resin system specially formulated to provide a weatherproof surface applied over concrete and masonry surfaces, or approved equal.

1.05 SUBMITTALS

A. Product Data: Submit manufacturer's technical information including label analysis and application instructions for each material proposed for use.

B. Wall Sample:

1. General: For each coating system specified, provide eight (8) foot by eight (8) foot wall sample for Architect's approval prior to beginning Project application of each special coating system.

C. Manufacturer's recommended application procedures which, when approved by Architect, will become the basis for accepting or rejecting actual application procedures used on the Wall.

1.06 DELIVERY AND STORAGE

A. Lids must be kept tightly sealed. Do not allow moisture to enter containers.

B. Store containers in a dry place, upright and airtight at temperatures of forty-five (45°F) degrees F. and not exceeding one hundred (100°F) degrees F. Skins formed on surface of

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material must be removed prior to moving containers, mixing or using.

#### 1.07 JOB CONDITIONS

A. Apply coating only when temperature of surfaces to be coated and surrounding air temperatures are between forty-five (45°F) degrees F and one hundred (100°F) degrees F, unless otherwise permitted by manufacturer's printed instruction.

B. Do not apply over frozen surfaces, or when rain is imminent.

C. Incompatible substrate release agents, form oils, and any foreign material are removed prior to priming and coating.

D. Roof and parapet top caps are installed and sealed against water penetration prior to priming and coating.

E. Primer shall not be exposed to ultra violet for more than four (4) weeks prior to application of coating. If exposure exceeds four (4) weeks, primer shall be re-coated, as recommended by manufacturer.

F. Material use is above grade only. Do not use below grade.

G. Paintable Joint Sealants must cure per manufacturer's recommendation. All joint sealants must be cleaned and wiped with an acetone solvent or approved cleaner prior to priming and coating.

#### 1.08 WARRANTY

A. On completion, in accordance with manufacturer's current written specifications, provide Owner with manufacturer's written "Limited Warranty" for product replacement.

### PART 2- PRODUCTS

#### 2.02 MATERIALS

A. Tilt-Up, Pre-Cast, and Cast-In-Place Concrete Coating System:

1. TEX•COTE® XL-70 "W" Textured Coating, XL-70 "W" Primer, XL-70 Solvent Primer.

2. Textures: To be selected by Architect. Available in smooth, sand, fine, and coarse textures.

3. Colors: To be selected by Architect.

B. Patching Compounds:

1. Fine Cracks up to 1/32": Brush or knife TEX•COTE® FLEX-PATCH® Smooth into cracks and bring to smooth and flush with concrete surface.

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2. Cracks larger than 1/32": Use cementitious patching compound with acrylic bonding adhesive agent. i.e.: ARDEX, SACK-CRETE or equal. Fill cracks and bring smooth and flush with existing surfaces.

## 2.03 EQUIPMENT

A. TEX•COTE® XL-70 "W" Primer, XL-70 Solvent Primer:

1. Spray Equipment: Graco 5900HD or equivalent with .015-.019 tip sizes.
2. Suitable for application by roller with 1/4"-3/4" nap roller cover or brush.

## PART 3 - EXECUTION

### 3.01 INSPECTION

A. Applicator must examine areas and conditions under which special coating work is to be applied and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until satisfactory conditions have been corrected in a manner acceptable to applicator.

### 3.02 SURFACE PREPARATION

A. General: Perform preparation and cleaning procedures in accordance with coating system manufacturer's instructions and as herein specified, for each particular substrate and coating condition.

1. Remove hardware accessories, machined surfaces, plates, lighting fixtures and similar items in place and not to be finish-coated or provide surface applied protection prior to surface preparation and coating operations. Remove, of necessary, for complete coatings of items and adjacent surfaces. Following completion of coating of each area, reinstall removed items.
2. All surfaces shall be sound and clean prior to application of primer and coatings. Such surface contaminants as dust, dirt, mildew, form oils, release agents, loose substrate, etc., shall be removed by water-blasting. Excessive form oils, release agents and curing compounds may require light sandblasting. Water-blasting/ power-washing of all surfaces to be coated is required.
3. Mask all glass, shrubbery and asphalt surfaces.
4. Caulked Panel Joints must cure per manufacturer's recommendation. All joint sealants must be cleaned and wiped with an acetone solvent or approved cleaner prior to priming and coating. Primer shall be applied to all joint sealants prior to application of coating.

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### 3.03 MATERIALS PREPARATION

- A. Mix and prepare coating materials in accordance with manufacturer's directions.
- B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of coatings in a clean condition, free of foreign materials and residue.
- C. Stir materials before application to produce a mixture of uniform density, and stir as required during application. Do not stir surface film into material. Remove film, and if necessary, strain material before using.

### 3.04 APPLICATION

- A. Apply coating in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.
- B. Concrete System:
  - 1. Primer Coat – Typical Tilt-Up or Pre-Cast concrete does not require the use on a primer prior to the application of TEX•COTE® XL-70 “W” Textured Coatings. When a primer coat is desired, apply TEX•COTE® XL-70 “W” Primer at a rate of 250-350 square feet per gallon. For concrete surfaces that exhibit chalking, calcium hydroxide, efflorescence, or other problems that may inhibit adhesion, apply TEX•COTE® XL-70 Solvent Primer at a rate of 175-300 square feet per gallon.
  - 2. Textured Coating – Apply TEX•COTE® XL-70 “W” Textured Coating at a rate of 45 +/- 5 square feet per gallon in the desired texture. Application shall be a uniform film thickness over the entire surface being covered. Minimum dry film thickness is approximately 15 mils.
- 3. A wet edge shall be maintained to prevent lap-marks.
- C. Avoid starting and stopping midway on wall. Continue to a natural break such as a panel edge or corner.

### 3.05 CLEANING AND PROTECTION

- A. General:
  - 1. Clean-up: During progress of work, remove from site discarded coating materials, rubbish, cans and rags at end of each work day.
  - 2. Upon completion of coating work, clean window glass and other coating splattered surfaces. Protect work of other trades, whether to be coated or not, against damage by coating and finishing work. Correct any damage by cleaning, repairing or replacing, and recoating, as acceptable to Architect.

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3. Provide "wet paint" signs as required protecting newly-coated finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of coating operations
4. At the completion of work of other trades, touch-up and restore all damaged or defaced surfaces.

END OF SECTION

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SECTION 099733 - CONCRETE FLOOR SEALER

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
  - 1. Concrete sealer for:
    - a. Uncured concrete floors.
    - b. Cured concrete floors.

1.2 ACTION SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics.
- B. Manufacturer's Installation Instructions:
  - 1. Submit surface preparation and application instructions.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept concrete sealer on site in manufacturer's original unopened containers. Inspect for damage.
- B. Protect concrete sealer from freezing.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not install concrete sealer when air temperature or concrete surface temperature is less than 40 degrees F
- B. Maintain concrete floor surface temperature above freezing during and after installation of concrete sealer until sealer is cured.

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## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Curecrete Chemical Company; Ashford Formula.
  - 2. The Euclid Chemical Company; Euco Diamond Hard.
  - 3. L&M Construction Chemicals, Inc.; Seal Hard.
- B. Concrete Sealer: Clear, penetrating, reactive VOC compliant, waterborne siliconate compound designed to densify and seal concrete surfaces.

## PART 3 - EXECUTION

### 3.1 EXAMINATION - UNCURED APPLCIATION

- A. Verify final troweling is complete.
- B. Verify concrete is set sufficiently so application of concrete sealer will not mar concrete surface.

### 3.2 EXAMINATION - CURED APPLICATION

- A. Verify floor surfaces are free of substances that may impair penetration of concrete sealer.

### 3.3 PREPARATION

- A. Remove membrane forming curing compounds and other surface contaminants capable of impairing concrete sealer penetration into concrete.
- B. Remove contaminants by chemical or mechanical means as recommended by concrete sealer manufacturer.
- C. Allow floor to dry. Broom clean floor surface to remove loose dust and dirt.

### 3.4 INSTALLATION - UNCURED APPLICATION

- A. Apply concrete sealer in accordance with manufacturer's instructions immediately after final troweling.
- B. Keep floor surface wet with concrete sealer for minimum 30 minutes.
- C. Broom concrete sealer as required for uniform coverage on floor surface.

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- D. Remove excess liquid material from floor surface.
- E. Saw Cut Floor Joints: Treat joints after cutting as specified in Section 033000.
  - 1. Remove cement dust from joints and floor surface.
  - 2. Treat saw cut joints by flooding with concrete sealer.
  - 3. When curing is complete, clean joints in preparation for sealant application as specified in Section 079000.
- F. Complete second application of concrete sealer just before Substantial Completion .

### 3.5 INSTALLATION - CURED APPLICATION

- A. Apply concrete sealer in accordance with manufacturer's instructions.
- B. Keep floor surface wet with concrete sealer for minimum 30 minutes.
- C. Scrub concrete sealer into concrete surface with mechanical scrubbers.
- D. Remove excess liquid material from floor surface.
- E. Rinse floor when required to remove excess concrete sealer.

### 3.6 PROTECTION OF FINISHED WORK

- A. Prohibit traffic on floor finish for 8 hours after installation.

### 3.7 CLEANING

- A. Remove concrete sealer residue from floor surface.

END OF SECTION



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SECTION 10 11 00 - VISUAL DISPLAY UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tackable visual display wall panels, custom-fabricated and fabric-finished.

1.02 REFERENCES

- A. ASTM International:
  - 1. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.

1.03 SYSTEM DESCRIPTION

- A. Performance Requirements:
  - 1. Surface Burning Characteristics (ASTM E84):
    - a. Flamespread: 25 maximum.
    - b. Smoke Developed: 450 maximum.
    - c. Fire ratings for all fabric covered panels is based on testing of the panel wrapped with the standard in stock fabric, Guilford of Maine, Model FR 701.

1.04 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
- B. Product Data: Submit product data sheet, for specified products.
- C. Shop Drawings: Submit shop drawings showing layout, edge profiles and panel components, including anchorage, accessories, finish colors and textures.
- D. Samples: Submit selection and verification samples of finishes, colors and textures.
- E. Test Reports: Certified test reports showing compliance with specified performance requirements.
  - 1. Standard Systems: Submit certified copies of previous test reports substantiating performance of system in lieu of retesting.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with Division 1 Product Requirements Section.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

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1.06 PROJECT CONDITIONS

- A. Environmental Requirements: Do not install panels until wet work, such as concrete and plastering, is complete; the building is enclosed; and the temperature and relative humidity are stabilized at 60 - 80 degrees F (16 - 27 degrees C) and 35% MINIMUM RH and 55% MAXIMUM RH, respectively. All products constructed with wood or wood fiber content must be stored for at least 72 hours in the controlled environment specified herein prior to installation to allow the materials to stabilize.

PART 2 PRODUCTS

2.01 TACKABLE WALL PANELS

- A. Manufacturer: Kinetics Noise Control, Inc.  
1. Contact: PO Box 655, 6300 Irelan Place, Dublin, OH 43017; Telephone: (614) 889-0480; Fax: (614) 889-0540; E-mail: [intsales@kineticsnoise.com](mailto:intsales@kineticsnoise.com); Web site: [www.kineticsnoise.com](http://www.kineticsnoise.com).  
B. Substitutions: No substitutions permitted.

2.02 MANUFACTURED UNITS

- A. Hi-Tack Tackable Panels:  
1. Thickness: 3/4 inches (19.1 mm)  
2. Size: As indicated on the drawings up to a maximum 48 inches (1219 mm) x 120 inches (3048 mm) panel.  
3. Core: 3/4 inch (19.1 mm)] thick mineral fiber board, 24 pcf (384 kg/m<sup>3</sup>) density Perforated core.  
4. Edge Detail: Square  
5. Facing: 100% polyester fabric, FR 701 Style 2100 by Guilford of Maine  
a. Color: As indicated on Equipment and Finish Schedule in Drawings  
6. Mounting Accessories: Z-clips

PART 3 EXECUTION

1.01 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.

1.02 EXAMINATION

- A. Site Verification of Conditions: Verify that substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.  
1. Verify that stud spacing is 16 inches (406 mm) o.c., maximum, for panels installed over open studs.  
2. Do not install panels until unsatisfactory conditions are corrected.

3.03 CLEANING

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- A. Follow manufacturer's instructions for cleaning panels soiled during installation. Replace panels that cannot be cleaned to as new condition.
- B. Keep site free from accumulation of waste and debris.

END OF SECTION

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SECTION 101200 - DISPLAY CASES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Display cases.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

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 display cases. Include furnished specialties and accessories.
  - 2. Include electrical characteristics for illuminated display cases.
- B. Shop Drawings: For display cases.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Show location of seams and joints in tackboard panels.
  - 3. Include sections of typical trim members.
  - 4. Include diagrams for wiring of illuminated display cases.
- C. Samples for Initial Selection: For each type of exposed finish.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For display cases to include in maintenance manuals.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install display cases for indoor installations 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.

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- B. Field Measurements: Verify actual dimensions of openings for display cases by field measurements before fabrication.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain display cases from single source from single manufacturer.

### 2.2 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: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.3 DISPLAY CASE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. A-1 Visual Systems as basis of design.
  - 2. AARCO Products, Inc.
  - 3. ADP Lemco, Inc.
  - 4. Architectural School Products Ltd.
  - 5. Best-Rite Manufacturing; A brand division of MooreCo, Inc.
  - 6. Claridge Products and Equipment, Inc.
  - 7. Ghent Manufacturing, Inc.
  - 8. Nelson-Harkins Industries.
  - 9. Newline Products, Inc.
  - 10. Platinum Visual Systems; a division of ABC School Equipment, Inc.
- B. Recessed Display Case: Factory-fabricated display case; with finished interior, operable glazed doors at front, and trim on face to cover edge of recessed opening.
  - 1. Display Case Cabinet: Hardwood veneer plywood.
    - a. Veneer Species: Maple with natural lacquered finish.
  - 2. Face Frame: Wood, species to match interior of cabinet box with natural lacquered finish.

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- C. Glazed Sliding Doors: Tempered glass; unframed; with extruded-aluminum top and bottom track; supported on nylon or ball-bearing rollers; with plastic top guide and rubber bumpers. Equip each door with ground finger pull and adjustable cylinder lock with two keys.
  - 1. Thickness: Not less than 6 mm thick.
  - 2. Number of Doors: Two.
- D. Shelves: 6-mm-thick tempered glass; supported on adjustable shelf standards and supports.
  - 1. Shelf Depth: 12 inches.
  - 2. Number of Shelves: Three.
- E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112; recess mounted in rear surface. Provide standards extending full height of display case.
- F. Hardwood Back Panel: Hardwood veneer to match display case construction.
- G. Illumination System: Provide LED light system as indicated on Drawings. Include lamps and internal wiring with single concealed electrical connection to building system. Coordinate electrical characteristics with power supply provided.
- H. Size: As indicated on Drawings.

## 2.4 MATERIALS

- A. Hardboard: ANSI A135.4, tempered.
- B. Fiberboard: ASTM C 208.
- C. Particleboard: ANSI A208.1, Grade M-1, made with binder containing no urea formaldehyde.
- D. Hardwood Plywood: HPVA HP-1, made with adhesive containing no urea formaldehyde.
- E. Extruded-Aluminum Bars and Shapes: ASTM B 221, Alloy 6063.
- F. Aluminum Tubing: ASTM B 429/B 429M, Alloy 6063.
- G. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering.
- H. High-Pressure Plastic Laminate: NEMA LD 3.
- I. Fasteners: Provide screws, bolts, and other fastening devices made from same material as items being fastened, except provide hot-dip galvanized, stainless-steel, or aluminum fasteners for exterior applications. Provide types, sizes, and lengths to suit installation conditions. Use security fasteners where exposed to view.
- J. Adhesives: Manufacturer's standard product.

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## 2.5 FABRICATION

- A. Fabricate display cases to requirements indicated for dimensions, design, and thickness and finish of materials.
- B. Use metals and shapes of thickness and reinforcing required to produce flat surfaces, and to impart strength for size, design, and application indicated.
- C. Fabricate cabinets and door frames with reinforced corners, mitered to a hairline fit, with no exposed fasteners.
- D. Fabricate shelf standards plumb and at heights to align shelf brackets for level shelves.

## 2.6 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 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 EXAMINATION

- A. Examine walls, 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 illuminated units.
- C. Examine walls and partitions for proper backing for display cases.
- D. Examine walls and partitions for suitable framing depth if recessed units will be installed.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare recesses for display cases as required by type and size of unit.

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### 3.3 INSTALLATION

- A. General: Install units in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
  - 1. Mounting Height: 72 inches above finished floor to top of cabinet.
- B. Recessed Display Cases: Attach units to wall framing with fasteners at not more than 16 inches o.c. Attach aluminum trim over edges of recessed display cases and conceal grounds and clips. Attach trim with fasteners at not more than 24 inches o.c.
- C. Comply with requirements specified elsewhere for connecting illuminated display cases.
- D. Install display case shelving level and straight.

### 3.4 ADJUSTING AND CLEANING

- A. Adjust doors to operate smoothly without warp or bind and so contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.
- B. Touch up factory-applied finishes to restore damaged areas.

END OF SECTION



## SECTION 101416 - PLAQUES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes dedication plaques.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For dedication plaque.
  - 1. Include fabrication and installation details and attachments to other work.
  - 2. Show plaque mounting heights, locations of supplementary supports to be provided by others, and accessories.
- 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.
- D. Samples for Verification: For each type of plaque showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
  - 1. Plaques: Full-size Sample
  - 2. Exposed Accessories: Full-size Sample of each accessory type.
- E. Plaque Schedule: Use same designations specified or indicated on Drawings or in a plaque or sign schedule.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Sample Warranty: For special warranty.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For plaques to include in maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer of products.

## 1.6 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 PLAQUES, GENERAL

### 2.2 PLAQUES

- A. Etched Plaque: 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, provide products by one of the following:
    - a. Ace Sign Systems, Inc.
    - b. Advance Corporation; Braille-Tac Division.
    - c. Allen Markings International.
    - d. APCO Graphics, Inc.
    - e. A. R. K. Ramos Signage Systems.
    - f. Diskey Sign Company.
    - g. Dixie Graphics.
    - h. Erie Landmark Company; Division of Paul W. Zimmerman Foundries.
    - i. Gemini Incorporated.
    - j. Matthews International Corporation; Bronze Division.
    - k. Metal Arts; Division of L & H Mfg. Co.
    - l. Metallic Arts.
    - m. Mohawk Sign Systems.
    - n. Nelson-Harkins Industries.
    - o. Steel Art Company.
  - 2. Plaque Material: Cast aluminum.
  - 3. Plaque Thickness: 0.050 inch.
  - 4. Finishes:
    - a. Integral Aluminum Finish: as selected by Architect.
    - b. Overcoat: Manufacturer's standard baked-on clear coating.
  - 5. Integral Edge Style: As indicated.
  - 6. Applied Frame Material, Style, and Finish: As indicated.
  - 7. Mounting: Concealed studs.
  - 8. Text and Typeface: As indicated on Drawings, to be reviewed with Owner.

## 2.3 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M, alloy and temper recommended by plaque manufacturer for casting process used and for type of use and finish indicated.
- B. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and 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. Use concealed fasteners and anchors unless indicated to be exposed.
  - 2. 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. Adhesives: As recommended by plaque manufacturer.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

## 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 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 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 panel surface indicated to produce precisely formed copy, incised to uniform depth.
  - 1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.

## 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.

## 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 plaque work.
- 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.
  - b. Thin or Hollow Surfaces: Place plaque in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
2. Through Fasteners: Drill holes in substrate using predrilled holes in plaque as template. Countersink holes in plaque if required. Place plaque in position and flush to surface. Install through fasteners and tighten.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed plaques and plaques that do not comply with specified requirements. Replace plaques 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 plaques are installed.
- C. On completion of installation, clean exposed surfaces of plaques according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain plaques in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Cast dimensional characters, pin-mounted.

1.2 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.
- 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: Half-size Sample of each type of dimensional character.
  - 2. Exposed Accessories: Half-size Sample of each accessory type.
- E. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.
- F. Delegated-Design Submittal: For signs indicated in "Performance Requirements" Article.
  - 1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

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## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

## 1.6 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 014000 "Quality Requirements," to design sign structure and anchorage of dimensional character sign type(s) to withstand design loads as indicated on Drawings.
- B. Thermal Movements: For exterior fabricated channel dimensional characters, allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

### 2.2 DIMENSIONAL CHARACTERS

- A. Fabricated Channel Characters: Metal face and side returns, formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and profiles; internally braced for stability and for securing fasteners; and as follows.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ACE Sign Systems, Inc.
    - b. APCO Graphics, Inc.
    - c. ASI Sign Systems, Inc.
    - d. Nelson-Harkins Industries.
    - e. Poblocki Sign Company, LLC.
    - f. Steel Art Company.
  - 2. Character Material: Sheet or plate aluminum.
  - 3. Material Thickness: As indicated.
  - 4. Character Height: As indicated.
  - 5. Character Depth: As indicated.
  - 6. Finishes:
    - a. Integral Aluminum Finish: Clear anodized.

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7. Mounting: Pin-mounted.
8. Typeface: As selected by Architect.

## 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, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish 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 stainless-steel devices unless otherwise indicated.
  3. Exposed Metal-Fastener Components, General:
  4. Sign Mounting Fasteners:
    - a. 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.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

## 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. 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. Internally brace signs for stability and for securing fasteners.
  6. 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.



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7. 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. 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.

## 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.

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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. Projecting 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 spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
  - b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.

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

## SECTION 101423 – PANEL SIGNAGE

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Panel signs: Room identification and code required signs.

#### 1.2 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 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. Panel Signs: Full-size Sample.
  - 2. Variable Component Materials: Full-size Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
- D. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Sample Warranty: For special warranty.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

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## 1.6 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.

## 1.7 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. 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. APCO Graphics, Inc.
  - 2. ASI Sign Systems, Inc.
  - 3. Best Sign Systems Inc.
  - 4. Fossil Industries, Inc.
  - 5. InPro Corporation.
  - 6. Mohawk Sign Systems.
  - 7. Vista System.
- B. Room Identification and Code Required Signage: 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 over subsurface graphics to acrylic backing sheet to produce composite sheet.
    - a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
    - b. Surface-Applied Graphics: Applied vinyl film.
    - c. Color(s): As selected by Architect from manufacturer's full range.
  - 2. Sign-Panel Perimeter: Finish edges smooth.

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3. Mounting: Manufacturer's standard method for substrates indicated with adhesive or two-face tape.

## 2.3 ACCESSORIES

- A. 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).
- B. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

## PART 3 - EXECUTION

### 3.1 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.
- B. Mounting Methods:
  1. 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.
  2. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
- C. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION

SECTION 102113 - PLASTIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Solid-plastic toilet compartments configured as toilet enclosures, shower screens, and urinal screens.

1.2 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 toilet compartments.
- B. Shop Drawings: For toilet compartments.
  - 1. Include plans, elevations, sections, details, and attachment details.
  - 2. Show locations of cutouts for compartment-mounted toilet accessories.
  - 3. Show locations of centerlines of toilet fixtures.
  - 4. Show ceiling grid, ceiling-mounted items, and overhead support or bracing locations.
- C. Samples for Initial Selection: For each type of toilet compartment material indicated.
  - 1. Include Samples of hardware and accessories involving material and color selection.
- D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
  - 1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch-square Samples of same thickness and material indicated for Work.
  - 2. Each type of hardware and accessory.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of toilet compartment.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments to include in maintenance manuals.

## 1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

## 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: 450 or less.
- B. Regulatory Requirements: 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 toilet compartments designated as accessible.

### 2.2 SOLID-PLASTIC TOILET COMPARTMENTS

- A. Manufacturers: Subject to compliance with requirements, provide product as indicated in Finish Schedule on Drawings of comparable product by one of the following:
  - 1. Scranton Products.
  - 2. ASI Global Partitions
  - 3. ASI Accurate Partitions
  - 4. Bradley Corporation; Mills Partitions.
  - 5. General Partitions Mfg. Corp.
  - 6. Hadrian Manufacturing Inc.
  - 7. Marlite.
  - 8. Metpar Corp.
  - 9. Partition Systems Incorporated of South Carolina; Columbia Partitions.
- B. Toilet-Enclosure Style: Ceiling hung.
- C. Urinal-Screen Style: Wall hung.
- D. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
  - 1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
  - 2. Color and Pattern: See Finish on Drawings.
- E. Pilaster Shoes: Manufacturer's standard design; polymer.
  - 1. Polymer Color and Pattern: See Finish Schedule.

- F. Brackets (Fittings):
  - 1. Full-Height (Continuous) Type: Manufacturer's standard design; extruded aluminum.
- G. Overhead Cross Bracing for Ceiling-Hung Units: As recommended by manufacturer and fabricated from solid polymer.

## 2.3 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.
  - 1. Hinges: Manufacturer's minimum 0.062-inch- thick stainless-steel paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door. Mount with through-bolts.
  - 2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast-stainless-steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.
  - 3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless-steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-bolts.
  - 4. Door Bumper: Manufacturer's heavy-duty rubber-tipped cast-stainless-steel bumper at out-swinging doors. Mount with through-bolts.
  - 5. Door Pull: Manufacturer's heavy-duty cast-stainless-steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

## 2.4 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M.
- B. Aluminum Extrusions: ASTM B 221.
- C. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- D. Stainless-Steel Castings: ASTM A 743/A 743M.
- E. Zamac: ASTM B 86, commercial zinc-alloy die castings.



## 2.5 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.
- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- wide, in-swinging doors for standard toilet compartments and 36-inch- wide, out-swinging doors with a minimum 32-inch- wide, clear opening for compartments designated as accessible.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
  - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
  - 1. Maximum Clearances:
    - a. Pilasters and Panels: 1/2 inch.
    - b. Panels and Walls: 1 inch.
  - 2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
    - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
    - b. Align brackets at pilasters with brackets at walls.
- B. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

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### 3.3 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION

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SECTION 102124 - CUBICLE CURTAINS AND TRACKS

PART 1 – GENERAL

1.01 SUMMARY

- A. Provide cubicle curtains and tracks not limited to the following applications.
  - 1. Nurse Suite
- B. Related Work:
  - 2. Section 095113 – Acoustical Panel Ceilings, for acoustical ceiling panels.
- C. Section includes:
  - 1. Ceiling mounted curtain track
  - 2. Track accessories and attachments
  - 3. Cubicle curtains

1.02 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets for all specified curtain track.
- B. Detail Drawings: Mounting details with the appropriate fasteners for specified project substrates.
- C. Samples: Verification samples of cubicle track, 4" (102mm) in length. Complete with (1) carrier as specified and stop.
- D. Manufacturer's standard installation instructions

1.03 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in unopened factory packaging.
- B. Inspect material on delivery to verify products are as specified.

1.04 WARRANTY

- A. Manufacturer's standard warranty against manufacturer defects.

PART 2 – PRODUCTS

2.01 MANUFACTURER

- A. Basis of Design - manufactured by Construction Specialties Subject to compliance with the requirements listed, provide cubicle curtains from the following manufacturer:
  - i. Construction Specialties, 3 Werner Way, Lebanon, NJ 08833.
- B. Drawings and specifications are based on manufacturer's literature from Construction Specialties, Inc. drawings and specifications unless otherwise indicated. Other manufacturers must be approved equal by Architect/Owner.

2.02 CUBICLE TRACK SYSTEM

- A. Cubicle Tracks: CS Cubicle Curtains #NL6062 Narrowline surface-mounted tracks of heavy extruded aluminum alloy 6063-T5, 29/32" x 11/16", slotted to receive roller carriers, complete with accessories and components required for complete and secure installations including splices, end caps and corner bends.
  - 1. Corner Bends: Corner bends up to 36" radius are to be fabricated in one continuous "L" shape. Radiuses above 36" to be continuous or spliced based on

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room condition.

i. Finish: White powder coat

B. Carriers:

1. CS Cubicle Curtains NL1062, virgin nylon axle with nylon wheels complete with nickel-plated brass dual hook assembly.
  - i. Provide one carrier for each 6" of cubicle curtain width.

2.03 CUBICLE CURTAINS

- A. Cubicle Curtain Fabric: Provide 100% polyester curtains. Fabric is to be opaque, washable, flame retardant and closely woven.
- B. HushCurtain® Acoustical Cubicle Curtains
  1. Performance characteristics
    - a.Noise Reduction Coefficient (NRC): 0.95
    - b.Sound Transmission Class (STC): 11
    - c.Flame Retardant (NFPA 701 Full Assembly Test): Pass
    - d.HIPAA Compliant
- C. Pattern & Color:
  1. Cubicle Curtain Fabric: Architect to select solid or patterned fabric from manufacturer's standard selection.
  2. Antimicrobial Treatment:
    - a. Nanotex + BioAM spill & stain resistant treatment combined with an antimicrobial agent for protection of fabrics within healthcare settings.

2.04 FABRICATION

1. Vertical Curtain Seams: Shall be double needle interlocked.
2. Label: Shall be sewn into the top hem of each curtain to identify the width of curtain.
3. Mesh Tops: Flameproof nylon mesh, mesh must have ½" spacing as per NFPA requirements. Mesh is to be completely bound with same fabric as the body of the curtain. Mesh to be 19" high at top of curtains.
4. Curtains to finish
  - a. 15" above the finished floor.
5. Panel Size:
  - a. 69 inches wide by 92 inches high including 19 inches of mesh, hemmed as required.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Installation of Cubicle Curtains and Tracks: Install in accordance with manufacturer's recommendations, including the following:
  1. Verify that ceilings are suitable for installation prior to installation.
  2. Mechanically attach tracks using manufacturer's recommended anchors and attachment devices.
  3. Install accessories and curtains and test for proper operation. Replace damaged units.

END OF SECTION

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## SECTION 102226 OPERABLE 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. This Section includes the following:

- 1. Manually operated, individual panel operable partitions.

- B. Related Sections include the following:

- 1. Division 03 Sections for concrete tolerances required.
  - 2. Division 05 Sections for primary structural support, including pre-punching of support members by structural steel supplier per operable partition supplier's template.
  - 3. Division 06 Sections for wood framing & supports, and all blocking at head and jambs as required.
  - 4. Division 09 Sections for wall and ceiling framing at head and jambs.

#### 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified in writing by the operable partition manufacturer, as qualified to install the manufacturer's partition systems for work similar in material, design, and extent to that indicated for this Project.
- B. Acoustical Performance: Test operable partitions in an independent acoustical laboratory in accordance with ASTM E90 test procedure and classified in accordance with ASTM E413 to attain no less than the STC rating specified. Provide a complete and unedited written test report by the testing laboratory upon request.
- C. Preparation of the opening shall conform to the criteria set forth per ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.
- D. The operable wall must be manufactured by a certified ISO-9001-2015 company or an equivalent quality control system.
- E. Indoor Air Quality: Operable partition, movable wall manufacturer's non-wood products must meet the SCS Indoor Advantage™ Gold Certification or equivalent. This approval guarantees conformance to indoor air concentrations meeting Indoor Advantage Gold Indoor Air Quality Certified to SCS-105 v4.2-2023 Conforms to ANSI/BIFMA M7.1 and X7.1 and the CDPH/EHLB Standard Method (CA 01350) v1.2-2017 conducted in an independent third-party air quality testing laboratory.

#### 1.4 REFERENCE STANDARDS

A. ASTM International

1. ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.
2. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
3. ASTM E84 - Surface Burning Characteristics of Building Materials.
4. ASTM E413 - Classification for Rating Sound Insulation

B. Health Product Declaration Collaborative

1. Health Product Declaration Open Standard v2.1

C. International Standards Organization

1. ISO 14021 - Environmental Labels and Declarations - Self-Declared Environmental Claims (Type II Environmental Labeling).
2. ISO 14025:2011-10, Environmental Labels and Declarations - Type III Environmental Declarations - Principles and Procedures.
3. ISO 14040:2009-11, Environmental Management - Life Cycle Assessment - Principles and Framework.
4. ISO 14044:2006-10, Environmental Management - Life Cycle Assessment - Requirements and Guidelines.
5. ISO 21930 – Sustainability in Buildings and Civil Engineering Works — Core Rules for Environmental Product Declarations of Construction Products and Services.

D. Other Standards

1. ADA – Americans with Disabilities Act.

#### 1.5 SUBMITTALS

A. Product Data: Material descriptions, construction details, finishes, installation details, and operating instructions for each type of operable partition, component, and accessory specified.

B. Shop Drawings: Show location and extent of operable partitions. Include plans, elevations, sections, details, attachments to other construction, and accessories. Indicate dimensions, weights, conditions at openings, and at storage areas, and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, including floor tolerances required and direction of travel. Indicate blocking to be provided by others.

C. Setting Drawings: Show imbedded items and cutouts required in other work, including support beam punching template.

D. Samples: Color samples demonstrating full range of finishes available by architect. Verification samples will be available in same thickness and material indicated for the work.

E. Reports: Provide a complete and unedited written sound test report indicating glass thickness and spacing in test specimen matches product as submitted.

F. Create spaces that are healthy for occupants.

1. Furnish products and materials with Health Product Declaration (HPD), Manufacturer Inventory, or other material health disclosure documentation. Products without an HPD or other disclosure documentation are not acceptable.

G. Furnish materials that generate the least amount of pollution.

1. Furnish products and materials that have third party verified environmental product declarations (EPD's). Consider products and materials that have optimized environmental performance (reduced life cycle impacts). Products without an EPD or other disclosure documentation are not acceptable.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Clearly mark packages and panels with numbering systems used on Shop Drawings. Do not use permanent markings on panels.

B. Protect panels during delivery, storage, and handling to comply with manufacturer's direction and as required to prevent damage.

## 1.7 WARRANTY

A. Provide written warranty by manufacturer of operable partitions agreeing to repair or replace any components with manufacturing defects.

B. Warranty period: Three (3) years.

## PART 2 – PRODUCTS

### 2.1 MANUFACTURERS, PRODUCTS, AND OPERATION

A. Manufacturers: Subject to compliance with requirements, provide products by the following:  
1. Modernfold, Inc.

B. Panels to be manufactured in the U.S.A.

C. Products: Subject to compliance with the requirements, provide the following product:  
1. Acousti-Seal Encore™ – Single Panel: Manually operated individual panel operable partition.  
2. Acousti-Seal Legacy – Paired Panel (932) manually operated paired panel operable partition.

### 2.2 OPERATION

A. Acousti-Seal Encore™ – Single Panel: Series of individual flat panels, manually operated, top supported with operable floor seals and automatic top seals.

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C. Acousti-Seal Legacy – Paired Panel (932): Series of paired flat panels hinged together in pairs, manually operated, top supported with operable floor seals.

C. Final Closure:

1. Horizontally expanding panel edge with removable crank

## 2.3 PANEL CONSTRUCTION

### Acousti-Seal Encore Single Panel

A. Nominal 4-1/4-inch (108 mm) thick panels in manufacturer's standard 51-inch (1295 mm) widths. All panel horizontal and vertical framing members fabricated from minimum 16-gage formed steel with overlapped and welded corners for rigidity. Top channel is reinforced to support suspension system components. Frame is designed so that full vertical edges of panels are of formed steel and provide concealed protection of the edges of the panel skin.

B. Panel Skin:

1. Roll-formed steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Acoustical ratings of panels with this construction:

a. 52 STC - 21-gage steel

### Acousti-Seal Legacy Paired Panel

A. Nominal 3-inch (76mm) thick panels in manufacturer's standard 48-inch (1220mm) widths. All panel horizontal and vertical framing members fabricated from minimum 16-gage formed steel with overlapped and welded corners for rigidity. Top channel is reinforced to support suspension system components. Frame is designed so that full vertical edges of panels are of formed steel and provide concealed protection of the edges of the panel skin.

B. Panel Skin:

1. Roll-formed 21-gage steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Acoustical ratings of panels with this construction:

a. 52 STC - 21-gage steel

## 2.4 PANEL FINISHES

A. Panel face finish shall be per Drawings.

## PART 3 – EXECUTION

### 3.1 INSTALLATION



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- A. General: Comply with ASTM E557, operable partition manufacturer's written installation instructions, Drawings and approved Shop Drawings.
- B. Install operable partitions and accessories after other finishing operations, including painting have been completed.
- C. Match operable partitions by installing panels from marked packages in numbered sequence indicated on Shop Drawings.
- D. Broken, cracked, chipped, deformed or unmatched panels are not acceptable.

### 3.2 CLEANING AND PROTECTION

- A. Clean partition surfaces upon completing installation of operable partitions to remove dust, dirt, adhesives, and other foreign materials according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions in a manner acceptable to the manufacturer and installer that ensure operable partitions are without damage or deterioration at time of Substantial Completion.

### 3.3 ADJUSTING

- A. Adjust operable partitions to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and other moving parts.

### 3.4 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 partitions. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.5 DEMONSTRATION

- A. Demonstrate proper operation and maintenance procedures to Owner's representative.
- B. Provide Operation and Maintenance Manual to Owner's representative.

END OF SECTION

SECTION: 102233 – ACCORDION FOLDING FIRE PARTITIONS

PART 1 – GENERAL

1.01 SUMMARY OF WORK

- A. Division 0 and 1, as indexed, apply to this section.
- B. Furnish and install all horizontal sliding, accordion folding fire partitions shown on the drawings and specified herein.

1.02 RELATED SECTIONS

- A. All headers, support structures, fire protection of support structures, surrounding insulation, jambs, storage pockets, pocket doors, access doors, blocking and trim shall be furnished and installed by other sections.
- B. All electrical wire, wiring, conduit and electrical boxes shall be furnished and installed by electrical section including connections to smoke detectors and building fire alarm panels.
- C. Drilling/placement of anchorage points into pre or post tensioned decks, welding/punching/drilling steel members and all drywall work.
- D. All track, soffit, chain guide and wall mounted striker posts shall be painted by Section 09 90 00. Color shall be selected by the architect.

1.03 QUALITY ASSURANCE

- A. Installation shall be performed by factory trained and certified installers with a minimum of three years' experience installing electrically operated accordion folding fire partitions.
- B. Fire partitions shall be listed by Underwriters Laboratories for ratings as indicated, when tested in accordance with the requirements of UL 263 and ASTM E-119.
- C. Automatic closing system shall be listed by Underwriters Laboratories in accordance with the requirements of UL 864 and be listed for use with assembly in compliance with NFPA 80.

1.04 SUBMITTALS

- A. Refer to Section 01 30 00 – Administrative requirements for shop drawings and submittals.
- B. Product Data: Provide manufacturer's technical literature, include UL listing data.
- C. Shop Drawings: Indicate construction and installation details and dimensions, including layout, electrical requirements, required stacking depth, height of header above finished floor, and requirements for anchorage and support of each fire partition.
- D. Operation and Maintenance Data: Operating procedures, troubleshooting and repair methods, and wiring diagrams.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver to the job site in manufacturer's original, unopened package.

1.06 COORDINATION BY GENERAL CONTRACTOR

- A. Coordinate with the following:
  - 1. Fire Alarm System.

2. Electrical.
  3. Pocket cover door (if required).
  4. Floor and ceiling finish.
  - B. Assure accurate installation of header, jamb, and trim. Provide "As-Built" dimensions for opening and storage pocket. Supervise unloading and handling of materials.
  - C. Store boxes flat (not more than three high) in a dry area and protect from elements that may damage materials.
  - D. Permanent power shall be in-place and ready for final connection when fire partitions are erected. Assure access to and proper clearance for motor operators.
  - E. After testing the fire alarm system, automatic-closing fire partitions shall be re-set to the original position.
- 1.07 WARRANTY
- A. Materials and installation shall be warranted against defects in workmanship for a period of two (2) years from the date of substantial completion.

## PART 2 – PRODUCTS

### 2.01 MANUFACTURER AND MODEL

- A. Accordion folding fire partition shall be Won-Door FireGuard Moveable Fire Wall model MFW1 as manufactured by Won-Door Corporation, Salt Lake City, UT.
- B. No substitutions allowed.

### 2.02 ACCORDION FIRE PARTITIONS - GENERAL

- A. Provide power operated self-closing fire partitions of configurations indicated on the drawings.
  1. Fire rating as required.
- B. Fire Rating: Fire partitions shall be listed by Underwriters Laboratory as special purpose fire partitions having a (*select one: 1 or 2*) hour fire protection rating in accordance with the requirements of UL 263 and ASTM E-119.
- C. Closing and Opening Operation: Automatic Closing System including motor operator and releasing devices shall be a Microprocessor-based system rated to UL864 (Releasing Device Control Unit) and shall commence closing upon activation by fire alarm system and/or by low battery voltage.
  1. Obstruction Detection: Contact with an obstruction shall cause the partition to stop, reverse enough to remove pressure on the leading edge, pause, and then re-close when in an alarm condition.
  2. Constant pressure to the leading edge while not under motor power shall prevent motor operation and allow the partition to be opened manually.

### 2.03 COMPONENTS

- A. Partition Construction: Two parallel, accordion-type walls of panels independently suspended with no floor tracks, pantographs, or interconnections except at the lead-post.

1. Panels: 24-gauge steel; V-grooved; modular design; capable of in-place repair.
2. Perimeter Seals: shall consist of continuous extruded sweeps attached to the top and bottom of the fire partition to form a smoke and draft seal.
3. Hanging weight shall be 6.5 pounds per square foot when extended across the opening.
4. Finish: All steel panels shall have factory applied protective coatings.
5. Color: Manufacturer's standard platinum.
- B. Suspension System: Two tracks, on 8-inch centers, attached to overhead structural support.
  1. Tracks: 14 gauge cold rolled steel.
  2. Panel hangers: Each panel suspended from a steel hanger pin and a ball bearing roller.
  3. Lead post hangers: 8-wheel ball bearing trolley.
- C. Power Supply: 120-volt power source to power supply for main power. On loss of AC power, the 12v/24v secondary power source shall provide full operation capability.
- D. Automatic Closing System shall be listed to UL864 including capability to send and receive signals from the Fire Control Panel and shall consist of the following:
  1. Microprocessor based Electronic Control box with the ability to:
    - a. Monitor dual power sources continually for peak performance including:
      - 1) Detect a missing battery, bad battery, or low battery condition.
      - 2) Detect if the charging circuit is bad.
      - 3) Detect fuse failures.
      - 4) Detect high or low AC conditions.
    - b. Monitor the health of the drive train.
    - c. Monitor inputs including faults associated with door block, exit hardware, patron hardware, and key switches.
    - d. Run a "watch dog" monitoring circuit which will force a software restart in the event the software hangs, including tracking the number of resets that occur for diagnostic purposes.
    - e. Withstand voltages up to 120 volts AC on the fire alarm input circuit without damage including the ability to indicate that the alarm circuit has not been wired as a dry contact, "no voltage" circuit when errant voltages are applied to the circuit.
    - f. Communicate with other microprocessors in the assembly via an internal bus system.
    - g. Indicate faults or supervised information both locally and at a remote location.
  2. Motor Operator Assembly including a DC gear-motor, drive sprocket, clutch, and position sensors. The motor shall drive the fire partition by means of a chain attached to a stabilizer bar trolley.
  3. A partition control momentary rocker switch shall be mounted on one side of the partition and shall function as follows:

- a. Pressing the upper portion of the switch shall close the partition and/or clear fault conditions.
  - b. Pressing the lower portion of the switch shall open the partition and/or temporarily mute the local horn.
4. Leading Edge shall be pressure sensitive such that contact with an obstruction shall cause the partition to stop, pause for 3 seconds, and then re-close when in an alarm mode.

## 2.04 OPTIONS

- A. Key Switch Module shall be provided by Won-Door.

## 2.05 RELATED CONSTRUCTION

- A. Track Support Construction: Provide supports attached to structure and mounting surface for track including drilling/placement of anchorage points into pre or post tensioned decks, welding/punching/drilling steel members, and all drywall work; comply with partition manufacturer's instructions and recommendations. Headers furnished & installed by the general contractor or other sections, shall be parallel with the finished floor within +/- 1/8" tolerance over the entire length of the opening.
- B. Pocket Construction: Provide rated pocket as specified for storage of accordion folding fire partition when open; comply with partition manufacturer's instructions and recommendations.
- C. Pocket Door: Maintain full pocket clear width when pocket door is open.
- D. Striker Recess: Mount 16-gauge steel striker in wall recess deep enough to prevent striker from protruding beyond face of wall; construct recess to maintain fire rating of wall.
- E. Protection: Protect installed work from damage.

## PART 3 – EXECUTION

### 3.01 EXAMINATION

- A. Verify that adjacent construction is suitable for installation of partition.
- B. Verify that electrical utilities have been installed and are accessible.
- C. Verify that partition opening is plumb, and header is parallel with the finished floor.
- D. Verify clear opening dimensions.
- E. Notify Architect of any unacceptable conditions or varying dimensions.

### 3.02 INSTALLATION

- A. Install fire partitions in accordance with manufacturer's instructions, shop drawings, and NFPA 80.
- B. Install fire partitions plumb and parallel with the finished floor.
- C. Installation shall be performed by factory trained and certified installers with experience installing electrically operated accordion folding fire products.

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3.03 ADJUSTING

- A. Adjust door installation to provide uniform clearances and smooth, quiet, non-binding operation.
- B. Test that all operations are functional and meet the requirements of local codes.

3.04 CLEANING

- A. Clean surfaces using manufacturer's recommended means and methods.

3.05 STORAGE OF WASTE AND RECYCLING

- A. Store and recycle waste in accordance with Section 01 74 19 Construction Waste Management and Disposal.

END OF SECTION

SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Corner guards.

1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide handrails capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Uniform load of 50 lbf/ft. applied in any direction.
  - 2. Concentrated load of 200 lbf applied in any direction.
  - 3. Uniform and concentrated loads need not be assumed to act concurrently.

1.3 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.
- B. Shop Drawings: For each impact-resistant wall protection unit showing locations and extent. Include sections, details, and attachments to other work.
  - 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Samples for Initial Selection: For each type of impact-resistant wall protection unit indicated.
  - 1. Include similar Samples of accent strips and accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
  - 1. Corner Guards: 12 inches long. Include examples of joinery, corners, end caps, top caps, and field splices.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each impact-resistant wall protection unit to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain impact-resistant wall protection units from single source from single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated. Refer to Section 014000 "Quality Requirements."
- D. Revise subparagraph below to suit Project.
  - 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.
- E. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store impact-resistant wall protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
  - 1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
  - 2. Keep plastic sheet material out of direct sunlight.
  - 3. Store plastic wall protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.
    - a. Store corner-guard covers in a vertical position.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F for not less than 72 hours before beginning installation and for the remainder of the construction period.



## 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall protection units that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures.
    - b. Deterioration of plastic and other materials beyond normal use.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Aluminum Extrusions: Alloy and temper recommended by manufacturer for type of use and finish indicated, but with not less than strength and durability properties specified in ASTM B 221 for Alloy 6063-T5.
- B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

### 2.2 CORNER GUARDS

- A. Flush-Mounted, Resilient, Plastic Corner Guards: Assembly consisting of snap-on plastic cover that is flush with adjacent wall surface, installed over continuous retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition; full wall height.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide InPro Corporation; IPC Interior Protection Products and Decorative Surfaces; G2-160F Flush Mount Corner Guard or comparable product by one of the following:
    - a. IPC Door and Wall Protection Systems; Division of InPro Corporation.
    - b. American Floor Products Co., Inc.
    - c. Balco, Inc.
    - d. Construction Specialties, Inc.
    - e. Korogard Wall Protection Systems; a division of RJF International Corporation.
    - f. Nystrom Building Products.
    - g. Pawling Corporation.
    - h. Wallguard.com.
  - 2. Cover: Extruded rigid plastic, minimum 0.80 inch wall thickness; in dimensions and profiles indicated on Drawings.
    - a. Color and Texture: As selected by Architect from manufacturer's full range.
  - 3. Retainer: Minimum 0.070-inch-thick, one-piece, extruded aluminum.

## 2.3 FABRICATION

- A. Fabricate impact-resistant wall protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.
- B. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.
- D. Miter corners and ends of wood handrails for returns.

## 2.4 METAL FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
  - 1. Remove tool and die marks and stretch lines, or blend into finish.
  - 2. Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - 3. Run grain of directional finishes with long dimension of each piece.
  - 4. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- B. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of work.
- B. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
  - 1. For impact-resistant wall protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

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### 3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

### 3.3 INSTALLATION

- A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
  - 1. Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings.
  - 2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
    - a. Provide anchoring devices to withstand imposed loads.
    - b. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches.
    - c. Adjust end and top caps as required to ensure tight seams.

END OF SECTION

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## SECTION 102800 - TOILET ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes:
  - 1. Public-use toilet accessories.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
  - 1. Construction details and dimensions.
  - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
  - 3. Material and finish descriptions.
  - 4. Features that will be included for Project.
  - 5. Manufacturer's warranty.
- B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.
  - 1. Approved full-size Samples will be returned and may be used in the Work.
- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
  - 1. Identify locations using room designations indicated.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products 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.

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1.6 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

PART 2 - PRODUCTS

2.1 TOILET ACCESSORIES

- A. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated on Drawings or comparable product by one of the following:
  - 1. Vondrehle
  - 2. Hillyard
  - 3. Bobrick Washroom Equipment, Inc.
  - 4. A & J Washroom Accessories, Inc.
  - 5. American Specialties, Inc.
  - 6. Bradley Corporation.

2.2 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

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3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION

SECTION 104313 - DEFIBRILLATOR CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Automated external defibrillator cabinets.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Show hardware, defibrillator cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed mounting method and relationships of box and trim to surrounding construction.
- B. Shop Drawings: For external defibrillator cabinets. Include plans, elevations, sections, details, and attachments to other work.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For AED cabinets to include in 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. Coordinate device mounting locations with authorities having jurisdiction and obtain approval in writing prior to installation.

1.5 COORDINATION

- A. Coordinate size of defibrillator cabinets to ensure that type and capacity of AEDs to be provided by others are accommodated.
- B. Coordinate sizes and locations of defibrillator cabinets with wall depths.

1.6 PREINSTALLATION CONFERENCE

- A. Preinstallation Conference: Conduct conference at Project site.

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## PART 2 - PRODUCTS

### 2.1 AUTOMATED EXTERNAL DEFIBRILLATOR (AED) CABINET

- A. Basis of Design Manufacturer: Physio-Control Recessed-Mount Stainless Steel AED Cabinet with Audible Alarm Part Number: 11220-000078.
  - 1. Recessed: 14 inch x 14 inch x 6.125 inch.
  - 2. Glazing: Manufacturer's standard polycarbonate.
  - 3. Alarm: Door activated alarm.
  - 4. Signage: AED Projection Wall Sign.
  - 5. Provide all accessories required for a complete installation

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare recesses for recessed cabinets as required by type and size of cabinet and trim style.

### 3.3 INSTALLATION

- A. General: Install AED cabinets in strict accordance with manufacturer's printed instructions and recommendations in locations at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- B. AED Cabinets: Fasten cabinets to structure, square and plumb.
  - 1. Unless otherwise indicated, provide recessed cabinets. If wall thickness is inadequate for recessed cabinets, provide semi recessed cabinets.

### 3.4 ADJUSTING AND CLEANING

- A. On completion of defibrillator cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- B. Replace defibrillator cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.



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END OF SECTION

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Fire-protection cabinets for the following:
    - a. Portable fire extinguishers.

1.2 PREINSTALLATION CONFERENCE

- A. Preinstallation Conference: Conduct conference at Project site.

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-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 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 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.

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## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

### 2.2 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
  - 1. Products: Subject to compliance with requirements, provide Larsens Manufacturing Company; Occult Series or comparable product by one of the following:
    - a. Fire-End & Croker Corporation.
    - b. Guardian Fire Equipment, Inc.
    - c. JL Industries, Inc.; a division of the Activar Construction Products Group.
    - d. Larsens Manufacturing Company.
    - e. Nystrom, Inc.
    - f. Potter Roemer LLC.
    - g. Strike First Corporation of America.
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Stainless steel sheet.
- D. Recessed Cabinet:
  - 1. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box to act as drywall bead.
- E. Cabinet Trim Material: Stainless Steel sheet.
- F. Door Material: Stainless Steel sheet.
- G. Door Style: Flush opaque panel, frameless, with no exposed hinges..
- 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 projecting lever handle with cam-action latch.
  - 2. Provide continuous hinge, of same material and finish as trim, 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.

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- a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
  - 1) Location: Applied to location indicated on Drawings.
  - 2) Application Process: Engraved.
  - 3) Lettering Color: Red.
  - 4) Orientation: Vertical.

J. Materials:

1. Stainless Steel: ASTM A 666, Type 304.
  - a. Finish: No. 4 directional satin finish.

## 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 thick.
  2. 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.

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## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare recesses for recessed 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 or, if not indicated, at heights indicated below:
  - 1. Fire-Protection Cabinets: 54 inches above finished floor to top of cabinet.
- 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 semirecessed 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.

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- 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

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SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Results:
  - 1. Multipurpose dry chemical fire extinguishers on mounting brackets at back of house and utility locations.
  - 2. Multipurpose dry chemical fire extinguishers within cabinets at other locations.
- B. Principal Products
  - 1. Fire extinguishers.
  - 2. Mounting brackets.

1.2 ACTION SUBMITTALS

- A. Product Data: For each extinguisher and bracket type.
  - 1. Include rating, classification, material descriptions, dimensions, profiles, and finishes.

1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers.

1.5 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.

### 2.2 FIRE EXTINGUISHERS

- A. Fire Extinguishers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Amerex Corporation.
    - b. JL Industries, Inc.; a division of the Activar Construction Products Group.
    - c. Larsens Manufacturing Company.
    - d. Potter Roemer LLC.
  - 2. Valves: Nickel-plated, polished-brass body.
  - 3. Handles and Levers: Stainless steel.
  - 4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- B. Multipurpose Dry-Chemical Type: UL-rated 4-A:80-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container with chrome plated brass valve.
  - 1. Amerex; Model B441.
  - 2. J.L. Industries; Cosmic 10E
  - 3. Larsen's Manufacturing Company; MP10
  - 4. Potter Roemer; 3010.

### 2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel to secure fire extinguisher to wall or structure, sized for specified fire extinguishers, with plated or red baked-enamel finish.
  - 1. Manufacturers: Same as fire extinguisher.
- B. Identification: Lettering complying with authorities having jurisdiction.
  - 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. Replace defective fire extinguishers.

3.2 INSTALLATION

- A. Install mounting brackets at locations indicated on Drawings.
  - 1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.
  - 2. Fasten mounting brackets to surfaces, square and plumb.
- B. Install fire extinguishers inside fire extinguisher cabinets.
- C. Hang fire extinguisher on mounting brackets and secure to brackets.

END OF SECTION

## SECTION 107516 - GROUND-SET FLAGPOLES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes ground-set flagpoles made from aluminum.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.
- B. Delegated Design Submittals: For flagpoles.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain flagpoles as complete units, including fittings, accessories, bases, and anchorage devices, 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 flagpole assemblies.
- B. Structural Performance: Flagpole assemblies, including anchorages and supports, to withstand design loads indicated within limits and under conditions indicated.
  - 1. Wind Loads: Determine according to NAAMM FP 1001. Basic wind speed for Project location is 110 MPH.

## 2.3 ALUMINUM FLAGPOLES

- A. Aluminum Flagpoles: Cone-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B241/B241M, Alloy 6063, with a minimum wall thickness of 3/16 inch (4.8 mm).
  - 1. Basis of Design Product: Concord American Flagpole; Sentry Series - ISC
- B. Exposed Height: 30 feet (9 m).
- C. Metal Foundation Tube: Manufacturer's standard corrugated-steel foundation tube, 0.060-inch (1.52-mm) wall thickness with 3/16-inch (4.8-mm) steel bottom plate and support plate; 3/4-inch- (19-mm-) diameter, steel ground spike; and steel centering wedges welded together. Galvanize foundation tube after assembly. Furnish loose hardwood wedges at top of foundation tube for plumbing pole.
- D. Sleeve for Aluminum Flagpole: Fiberglass or PVC pipe foundation sleeve, made to fit flagpole, for casting into concrete foundation.

## 2.4 FITTINGS

- A. Finial Ball: Flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.
  - 1. 0.063-inch (1.6-mm) spun aluminum with gold anodic finish.
- B. Internal Halyard, Cam Cleat System: 5/16-inch- (8-mm-) diameter, braided polypropylene halyard; cam cleat; and concealed revolving truck assembly with plastic-coated counterweight and sling. Furnish flush access door secured with cylinder lock. Finish truck assembly to match flagpole.
  - 1. Halyard Flag Snaps: Stainless steel swivel snap hooks. Furnish two per halyard.

## 2.5 MISCELLANEOUS MATERIALS

- A. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.
- B. Sand: ASTM C33/C33M, fine aggregate.
- C. Elastomeric Joint Sealant: joint sealant complying with requirements in Section 079200 "Joint Sealants."
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

## 2.6 ALUMINUM FINISHES

- A. Natural Satin Finish: AA-M32, fine, directional, medium satin polish; buff complying with AA-M20; seal aluminum surfaces with clear, hard-coat wax.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.
- B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.
- C. Foundation Tube: Place foundation tube, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level foundation tube and allow concrete to cure.
- D. Sleeves: Locate and secure sleeves in forms by bracing to reinforcement and forms.
- E. Place concrete, as specified in Section 033000 "Cast-in-Place Concrete." Compact concrete in place by using vibrators. Moist-cure exposed concrete for no fewer than seven days or use nonstaining curing compound.
- F. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

### 3.2 FLAGPOLE INSTALLATION

- A. General: Install flagpoles where indicated and according to Shop Drawings and manufacturer's written instructions.
- B. Foundation Tube: Place flagpole in tube, seated on bottom plate between steel centering wedges, and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch (50-mm) layer of elastomeric joint sealant and cover with flashing collar.

END OF SECTION

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SECTION 108213 - EXTERIOR GRILLES AND SCREENS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
  - 1. Fixed louvers, frames and accessories.
  - 2. Structural framing.

1.2 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Professional Seal: Sign and seal shop drawings and design calculations by professional engineer.
- C. Shop Drawings: Indicate equipment enclosure layout plan and elevations, louver panel sizes, mullions, clearance dimensions, tolerances; head, jamb and sill details; blade configuration, and louver frames. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.
- D. Product Data: Submit data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
- E. Design Calculations: Submit design calculations.
- F. Samples: Submit three samples 6 x 6 inch in size illustrating finish and color of aluminum surfaces.
- G. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.
- H. Manufacturer's Certificate: Certify that products meet or exceed specified requirements

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with AMCA Certification for louvers, in accordance with AMCA 500.
- B. Design support framing in accordance with AA Aluminum Design Manual.

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#### 1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Design under direct supervision of a professional engineer experienced in design of this work and licensed in Commonwealth of Pennsylvania.

#### 1.5 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

#### 1.6 COORDINATION

- A. Coordinate the Work with installation of metal siding, flashings, and roof membrane to maintain watertight building.
- B. Coordinate the Work with installation of mechanical equipment concealed by enclosure. Provide clearances required to maintain equipment.

#### 1.7 WARRANTY

- A. Provide twenty-year manufacturer warranty for metal finishes.
- B. Warranty: Include coverage for degradation of aluminum finish.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Wind Loads: Design and size components to withstand dead loads and live loads caused by positive and negative wind loads acting normal to plane of equipment enclosure, including building corners.
  - 1. As calculated in accordance with ASCE 7 - Calculation of Wind Loads, as measured in accordance with ASTM E330; Exposure A and basic wind speed of 80 mph.
- B. Deflection: Limit structural framing and louver mullion deflection to 1/180.
- C. Equipment Enclosure Assembly: Accommodate following without damage.
  - 1. Movement within system.
  - 2. Movement between system and perimeter framing and building components.
  - 3. Dynamic loading and release of loads.
  - 4. Deflection of structural support framing.

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## 2.2 LOUVERED EQUIPMENT ENCLOSURES

- A. Basis of Design: Architectural Louvers Co; Model V6NJ5 or comparable product one of the following:
  - 1. Construction Specialties.
  - 2. The Airolite Company.
  - 3. Industrial Louvers Inc.
- B. Product Description: Self supporting tubular aluminum structural framing with fixed blade aluminum wall louvers.

## 2.3 COMPONENTS

- A. Extruded Aluminum: ASTM B221, 6063 alloy, T-5 temper; extruded shape.
- B. Sheet Aluminum: ASTM B209, alloy and temper to suit application.
- C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210, Alloy 6063 , Temper T6.
- D. Aluminum-Alloy Bars: ASTM B211, Alloy 6063 , Temper T6.
- E. Bolts, Nuts, and Washers: Stainless steel.
- F. Welding Materials: AWS D1.1; type required for materials being welded.

## 2.4 LOUVER PANELS

- A. Louver Blade Depth: 6 inches
- B. Blade Spacing: 5 inch centers
- C. Blade Profile: Narrow profile plain blade without center baffle.
- D. Blade Nominal Thickness: Not less than 0.080 inch.
- E. Framing Support Nominal Thickness: Not less than 0.125 inch (3.2 mm)
- F. Louver Performance Requirements:
  - 1. Free Area: Not less than 11.7 sq. ft.for 48-inch- wide by 48-inch high louver assembly.
  - 2. Horizontal Drag Coefficient: Not greater than 0.29 on a cross sectional profile, allowing for a 71% reduction in wind load imposed horizontally upon supporting structural framing.
- G. Intermediate Mullions: Concealed of extruded aluminum, profiled to suit louver frame.

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## 2.5 ACCESSORIES

- A. Fasteners and Anchors: Stainless steel type.
- B. Flashings: Aluminum as specified in section 07 62 00 {07620}.
- C. Sealants: As specified in Section 07 90 00 {07900}.

## 2.6 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site. Fabricate to allow site assembly with bolted connections.
- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by continuous welds. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

## 2.7 FACTORY FINISHING

- A. High-Performance Organic Finish: 3-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements {01300 - Administrative Requirements}: Verification of existing conditions before starting work.
- B. Verify prepared substrate is ready to receive Work and framing anchor locations are as indicated on shop drawings.



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### 3.2 PREPARATION

- A. Supply steel items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections.

### 3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Install louvers level and plumb.
- D. Align louver assembly.
- E. Secure louvers in opening framing with concealed fasteners.
- F. Obtain approval prior to site cutting or making adjustments not scheduled.
- G. After erection, touch up damaged shop finishes.
- H. Install perimeter sealant and backing rod in accordance with Section 07 90 00 {07900}.

### 3.4 ERECTION TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story or for every 12 ft in height whichever is greater, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

### 3.5 REPAIR AND CLEANING

- A. Section 017000 - Execution and Closeout Requirements: Requirements for cleaning..
- B. Clean surfaces and components.

END OF SECTION

SECTION 113100 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Cooking appliances.
  - 2. Refrigeration appliances.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, dimensions, furnished accessories, and finishes for each appliance.
- B. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.
- C. Product Schedule: For appliances. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of appliance, from manufacturer.
- B. Field quality-control reports.
- C. Warranties: Sample of special warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.
- B. Regulatory Requirements: Comply with the following:
  - 1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

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- C. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1 .
- D. Preinstallation Conference: Conduct conference at Project site.

## PART 2 - PRODUCTS

### 2.1 RESIDENTIAL APPLIANCES

- A. Manufacturers and Products: Subject to compliance with requirements, provide products indicated in Equipment Schedule on Drawings or comparable products by one of the following:
  - 1. Whirlpool Corporation.
  - 2. Amana; a division of Whirlpool Corporation.
  - 3. BOSCH Home Appliances.
  - 4. Electrolux Home Products (Frigidaire).
  - 5. General Electric Company (GE).
  - 6. Jenn-Air; a division of Whirlpool Corporation.
  - 7. KitchenAid; a division of Whirlpool Corporation.
  - 8. LG Appliances.
  - 9. Maytag; a division of Whirlpool Corporation.
  - 10. Sears Brands LLC (Kenmore).

### 2.2 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.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.

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- C. Examine walls, ceilings, and roofs for suitable conditions where overhead exhaust hoods will be installed.
- 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, GENERAL

- A. General: Comply with manufacturer's written instructions.
- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.
- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- D. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions.
- E. Utilities: Comply with plumbing and electrical requirements.

END OF SECTION

SECTION 114000 - FOODSERVICE EQUIPMENT PART 1

- GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

1.2 SUMMARY

- A. Provide all material, labor, equipment and services required to execute and complete all items of work relating to the food service equipment, both existing and new, all as required to make the resulting facility a fully functional and reliable operating unit in accordance with this Specification. All food service equipment shall be furnished as specified, delivered prepaid, unloaded and uncrated, assembled with all components and accessories connected within the equipment, set-in-place in proper location as indicated on the drawings, leveled and fastened to the wall, ceiling or floor as required, left ready for final utility connections. The work shall include:
  - 1. To prevent extended warehousing of all food service equipment, no pre-ordering of equipment is permitted; schedule ordering of the equipment so that warehousing of the equipment shall not be required for longer than 60 days prior to delivery to the site for installation.
  - 2. All food service equipment shall have a manufacturer extended warranty covering parts and labor for a period of two years which shall take effect only after acceptance and beneficial use by the District. All labor shall be performed by a factory authorized and qualified representative.
  - 3. A "complete and thorough" demonstration and start-up for each item of equipment must be conducted by a qualified manufacturer representative in the use, sanitation and maintenance of the equipment.
- B. Furnishing scheduled items of custom fabricated food service equipment as specified utilizing a food service equipment fabricator listed with the National Sanitation Foundation (NSF) for custom equipment fabrication.
- C. Delivery of food service equipment in factory fabricated containers designed to protect equipment and finish until final installation. Delivery of food service equipment shall be coordinated with the construction schedule. If necessary, delivery of the food service equipment shall be by means other than common carrier to expedite delivery and to maintain project schedule.
- D. Warehousing of the food service equipment in a bonded warehouse and re-delivery of the food service equipment from the storage facility to the project site or arrangement for secured storage at the project site to assure availability of the food service equipment to maintain project schedule.

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- E. Field installation of the food service equipment including buy out equipment at the project site including on site receiving and unloading, uncrating from packing containers, conveyance of the food service equipment from the receiving area to the installation location, erection and assembly of the food service equipment including field welding and polishing of sub assemblies and installation of fixtures and components and setting in place in final location.
- F. Removal and disposal of discontinued items of food service equipment not to be reused including costs for transport and scrapping. This shall include pump-down and reclaim of refrigerant and fire system propellant and disposal costs of all refrigeration systems as required. Utility disconnection and termination of utility services shall be provided by the Plumbing, Electrical and Mechanical (HVAC) Trades.
- G. Removal and disposal of discontinued items of food service equipment not to be reused including costs for transport and scrapping. This shall include pump-down and reclaim of refrigerant and disposal costs of all refrigeration systems as required. Utility disconnection and termination of utility services shall be provided by the Plumbing, Electrical and Mechanical (HVAC) Trades.
- H. Removal, cleaning, servicing, reassemble and reinstallation of items of food service equipment to be reused including warehousing and transportation costs for scheduled items of food service equipment to be refurbished off-site or to be temporarily stored off-site. This shall include pump-down and reclaim of refrigerant and disposal costs of all refrigeration systems as required. Utility disconnection and termination of discontinued services and modification or preparation or relocated utility services shall be provided by the Plumbing, Electrical and Mechanical (HVAC) Trades.
- I. Removal, cleaning, servicing, crating and delivery including costs for transport of items of food service equipment to be reused in an alternate location. This shall include pump-down and reclaim of refrigerant and disposal costs of all refrigeration systems as required. Utility disconnection and termination of utility services shall be provided by the Plumbing, Electrical and Mechanical (HVAC) Trades.
- J. Removal and disposal of all packing material.
- K. All costs for special tools, crane rental or usage cost or rigging as may be required for delivery or installation of the food service equipment.
- L. All work is to be performed by skilled labor utilizing the proper Trades having respective jurisdiction thereto. All work shall be performed at hours required to maintain consistent work schedules with all other Trades without additional cost.
- M. Preparation of dimensioned utility rough-in floor plans coordinated with the Contract Documents and site conditions and the food service equipment manufacturers' utility connection points for all food service equipment.
- N. Assist in the preparation of "chalk-line" mark-up of utility rough-in locations on the building floor at the job site.

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- O. Take complete financial responsibility for any and all additional expenses resulting from incomplete or inaccurate rough-in drawings or instructions for the final rough-in dimensioning at the job site.
- P. Provide complete manufacturers' and fabricator shop drawings of all related items of food service equipment.
- Q. Provide competent on-site supervision for the coordination of work and to assist and supervise the erection, assembly and installation of the food service equipment, this shall include any moving, shifting or disassembly of the food service equipment to enable work to be performed free of obstruction.
- R. Attend all job conferences and meetings.
- S. Maintaining coordination and control over the form, fit, function and utility requirements of all food service equipment, from placement of purchase orders through Final Acceptance.
- T. Provide competent on-site final testing, demonstration and instruction in the use and service of all items of food service equipment in the form of a qualified manufacturer's representative for each item of food service equipment.
- U. Providing access to the custom equipment fabricator's shop for inspection of construction and materials used at any time during the progress of fabrication.
- V. Field verification of all measurements at the project site prior to the fabrication of custom fabricated and buy-out equipment and correct any deviation from the dimensions indicated on any plans and shop drawing which may affect the final form or fit of any item of food service equipment as a result of final building conditions and actual field dimensions.
- W. All food service equipment shall conform to field verified dimensions and to the finished building conditions with edges scribed and sealed to wall surfaces, fitting to and around building obstructions. All joints, seams or surfaces shall be fully sealed with General Electric or equivalent clear silicone sealer.
- X. Field verification of delivery access into and through the building to the final equipment location including access and clearance through hallways, doorways and elevators (cab size and weight restrictions); furnish food service equipment in sections or sub-assemblies as required for access.
- Y. Keeping the premise free from accumulation of waste material and rubbish caused by his work. At the completion of each workday all waste material and rubbish must be removed and all areas swept broom clean.
- Z. Physical damage to equipment, building or previous work completed or in the process of completion shall be repaired or replaced.
- AA. Furnish as part of and affixed to the food service equipment, accessories, components and fixtures furnished standard with the equipment as specified or listed as an option and shall include the following:

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1. PLUMBING ACCESSORIES: Pop-up, lever or basket type waste outlets, tailpieces, standing or connected overflows, faucets and spray units, vacuum breakers, shut-off and control valves and fittings.
  2. STEAM AND GAS ACCESSORIES: Steam supply valves, thermostats, pressure reducing and regulating valves, shut-off and control valves, temperature and pressure gauges, copper steam coils or injector assemblies, traps and fittings
  3. ELECTRICAL ACCESSORIES: Terminal blocks, conduit, wiring, signal and pilot lamps, on-off and control switches, control panels, magnetic contactor assemblies, heating elements, junction boxes, outlet boxes and receptacles and cord and plug sets.
  4. REFRIGERATION ACCESSORIES: Copper insulated refrigeration tubing, valves, fittings, hangers, high- and low-pressure control switches, solenoid valves, evaporator coils, expansion valves, condensing units and condensate evaporators.
- BB. All built-in accessories, components and fixtures shall be factory installed at the time of fabrication and shall comply with all applicable codes and regulations.
- CC. Furnish and install copper insulated refrigeration lines from compressor location to evaporator coils and expansion valves for all refrigeration units and ice makers with remote or refrigeration systems other than self-contained.
- DD. Furnish and install flexible stainless-steel gas flue tubing from exhaust collar on gas hot water booster heater terminating at the exhaust vent connection at the vent extension or condensate hood.
- EE. Furnish 14-gauge galvanized steel welded roof curbs for all refrigeration condensing unit stands and exhaust fans and supply fan make-up air units including setting-in- place and securing to the building roof.
- FF. Furnish and install in exhaust hood, plenum, duct and surface fire protection system. Entire system shall be furnished and installed in compliance with UL Standard 1254, UL Standard 300, NFPA 96 and any prevailing statutes or codes including automatic shut-down of all cooking appliances per code section 44 of NFPA 17A-27. The manufacturer of the fire suppression system shall be ISO 9001 registered. The entire installation must conform to ADA (American Disabilities Act) latest edition. The system shall be an automatic fire suppression system using a wet chemical agent for grease related fires. The system shall be the pre-engineered type having minimum and maximum guidelines established by the manufacturer and listed by Underwriters Laboratories (UL). The system shall be installed and serviced by certified personnel trained by the manufacturer. Provide as part of fire system, mechanically operated gas supply line shut-off valve to interrupt gas supply to all gas operated cooking appliances. Gas valve shall be provided with manual reset to prevent gas flow to pilot devices on appliances prior to restart.
- GG. Furnish and install remote and self-contained refrigeration system complete with condensing unit and insulated copper refrigeration lines charged with R448A refrigerant. Condensing unit shall be interconnected to a low profile, high velocity evaporator coil. Refrigeration system shall include all fittings, valves, switches, controls and all related components to comprise a complete operating unit of sufficient BTU capacity to maintain automatic operation of 35-degree F product temperature in



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coolers and -10-degree F product temperature in freezers. Refrigeration system provided with outdoor remote air-cooled condensing unit shall be provided with winterized controls (low ambient package) including crankcase heater, line dryers and head pressure control unless specified as part of a pre-assembled refrigeration rack system. Refrigeration lines to be run within any slab or floor shall be either hard copper or soft copper if run within conduit.

- HH. All electrical wiring, plumbing lines, gas lines (except exposed threaded pipe gas manifolds at cooking appliances), steam lines and refrigeration lines shall be concealed in the floor, walls or above the finished ceiling in an acceptable manner and in compliance with all applicable codes. Where it is impractical to run lines within the floor, walls or above the finished ceiling, lines shall be enclosed in a stainless steel (or alternate "smooth and cleanable" approved material) with appropriate access for service or replacement. In situations of an island arrangement or where equipment is not situated with access to a wall surface, lines must be installed in the floor in an approved manner including in-ground conduit for refrigeration and beverage lines. In no case shall any lines be "exposed".
- II. Furnish materials and install all interconnecting wiring as required for the food service equipment, except for exhaust ventilation and fire suppression systems. This shall include inter-wiring of control panels furnished as a part of a fixture or appliance, on-off switches for light fixtures furnished as a part of a fixture or appliance, inter-wiring of control devices to motors furnished as a part of a fixture or appliance, time clock circuits for freezers from remote condensing unit to evaporator coil, heated pressure relief ports in walk-in freezer, electrical receptacles furnished as a part of a fixture or appliance, light fixtures in walk-in refrigeration to on-off switches and conduit junction boxes, ceiling mounted heat lamps to remote wall switch and inter-wiring of food waste disposer from control device to disposer motor as required to complete the installation of the food service equipment. This work does not pertain to the any of the exhaust and supply ventilation systems on the project.
- JJ. Furnish materials and install heat tracing tape to all condensate lines within walk-in freezer; insulate entire heat tracing tape with foam pipe insulation.
- KK. Furnish materials and install all interconnecting plumbing as required for the food service equipment, except for exhaust ventilation and fire suppression systems. This shall include faucets, drains, drains with connected overflow, shut-off valves, vacuum breakers, flow or pressure control valves, gauges, bleeder tubes, piping from disposer control device to disposer cone and disposer body inlets and piping for steam operated equipment from boiler take-off valve at steam generator to steam inlet connection at appliance as required to complete the installation of the food service equipment.
- LL. Furnish materials and install insulated copper interconnecting piping between the dishmachine and the hot water booster heater, this shall include the installation of pressure and temperature gauges, strainer and shock absorber in the hot water supply line to the booster heater.
- MM. Furnish and install water filter assemblies, sized and of the proper type to accommodate the water flow rate and "particulate" requirement of the food service equipment; this shall include all combi and bake ovens, steam cookers, proofing

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cabinets, ice makers, coffee brewing equipment and soda and beverage dispensing equipment.

- NN. Furnish and install copper condensate lines in walk-in refrigeration from evaporator coil to waste receptor.
- OO. Furnish and install gas supply shut-off valve at each gas manifold connection and furnish and install flexible gas hose connectors to each shut-off valve and to each cooking appliance.
- PP. Furnish materials and install interconnecting chrome plated exposed piping for hose reel and hose bibs including installation of check valves and vacuum breaker in supply line; this shall include chrome plated bleeder outlet if required by local health department regulations or local plumbing codes.

### 1.3 WORK BY THE ELECTRICAL TRADE

- A. Rough-in utility connections including proper voltage, phase and amperage required to satisfactorily operate all items of food service equipment.
- B. Final connection of the food service equipment from the rough-in location to the connection point on all food service equipment and necessary connection points.
- C. All electrical components for the exhaust and supply ventilation system (including condensate hoods and pant leg vent systems) including, electrical disconnects, starters, exhaust fan on-off switch with indicator lights located in kitchen and supply fan controller with indicator lights located in kitchen and dishroom.
- D. Furnishing and installation of all accessories, components and fixtures other than those specified as part of the food service equipment, to include but not be limited to, electrical circuit breakers or fuses, electrical receptacles, disconnect switches, on-off switches or other fittings and appurtenances that are required to connect the food service equipment in accordance with manufacturer's instructions and result in proper operation.
- E. Utility disconnection and termination of discontinued services of existing food service equipment to be terminated.
- F. Furnishing and installing electrical plug and cord sets where not furnished as part of the appliance.
- G. Electrical contractors or shunt-trip circuit breakers to interrupt electrical power to all electrically operated food service cooking appliances.
- H. In-floor, flush mounted, waterproof electrical receptacles of type and capacity to match plug and cord sets for all mobile food service counter equipment.
- I. Ceiling mounted, retractable drop cords to accommodate food service equipment in an island arrangement, of the type and capacity to match plug and cord sets of the food service appliances.

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- J. Furnishing materials and installation of all interconnecting wiring as required for the food service exhaust ventilation and fire suppression systems; this shall include wiring of electrically operated gas supply shut-off valves for fire suppression systems, fire suppression system wiring to building fire alarm, heat detector electrical detection device to automatically start supply and exhaust fans and exhaust hood light fixtures to remote wall switch.

#### 1.4 WORK BY THE PLUMBING TRADE

- A. Rough-in utility connections including gas, steam, hot and cold water and floor receptors and drains in proper sizes, pressures and quantities required to satisfactorily operate all items of food service equipment.
- B. Final connection of the food service equipment from the rough-in location to the connection point on all food service equipment and necessary outlets.
- C. Furnishing and installation of all accessories, components and fixtures other than those specified as part of the food service equipment, to include but not be limited to stop cocks, traps, pipe, shut-off valves, pressure reducing valves or other fittings and appurtenances that are required to connect the food service equipment in accordance with manufacturer's instructions and result in proper operation.
- D. Furnishing and installing chrome plated indirect waste outlet piping for food service equipment, from the waste outlet connection on the food service equipment to the building waste receptacle (floor sink, etc.).
- E. Flushing and sanitizing of lines before making final connections to the food service equipment.
- F. Grease interceptors for food service equipment in capacity and size as required by code.
- G. Furnish and install exposed threaded gas manifold piping for all cooking appliances and welded in-wall gas manifold piping.
- H. Install gas shut-off valve supplied as part of the fire suppression system in the gas supply line in an exposed and accessible location.

#### 1.5 WORK BY THE MECHANICAL TRADE

- A. Supply and exhaust ventilation for indoor refrigeration condensing units based on 750 cfm for each air-cooled compressor horsepower and 250 cfm for each water-cooled compressor horsepower.
- B. Exhaust ventilation for condensate applications including fully welded 18-gauge stainless steel or 12-gauge aluminum liquid tight ductwork pitched toward source to prevent leaking, fan and start-stop switch with indicator lights located in the dishroom.

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- C. Exhaust hood exhaust ventilation system including roof top mounted “utility set” type up-blast centrifugal fan with backward incline wheel, adjustable sheaves, vibration mounts and bird screen at discharge end; fan shall be rated at 14 sones or less and shall be UL 710 listed; roof curb, exhaust ductwork constructed of a minimum 16 gauge galvanized steel or 18 gauge stainless steel, fully welded liquid tight with clean-outs at every major bend and in 20 foot intervals; ductwork shall not exceed a three to one aspect ratio, connection to exhaust fan shall include a UL listed and rated vibration eliminator and ductwork shall be insulated with all prevailing codes.
- D. Exhaust hood supply ventilation system including roof top mounted UL listed supply fan with vibration mounts, adjustable sheaves, roof curb, bird screen at intake end, maintainable filtration system, and gas or electric heated supply air heater (supply air heater heat incoming supply air below a 65-degree F ambient temperature) and 22- gauge galvanized steel ductwork.
- E. Disconnection and termination of discontinued ductwork of existing exhaust or condensate hoods to be terminated or relocated, and modification or preparation of exhaust system for existing exhaust or condensate hoods to be relocated at the new location.

#### 1.6 WORK BY THE CONSTRUCTION TRADE

- A. Masonry bases, floor curbs, structural pads, floor depressions, roof curbs, flues and fireproof duct shafts or enclosures.
- B. Conduit for beverage lines (PVC if embedded in concrete or smooth aluminum if exposed) with 24" radius sweep bends and 24" x 24" pull boxes every 100 lineal feet or three turns including sleeves any through walls, floors and ceilings.
- C. Sleeves and openings through wall, floors and ceilings for passage of refrigeration lines.
- D. Wall blocking or reinforcing to adequately support wall mounted food service equipment or fixtures; provide 3/4" thick exterior grade plywood backing for wood stud applications and 16-gauge steel backing for metal stud applications.
- E. Stainless steel or FPR wall paneling behind all mop receptors, dishtables and pot / utensil washing sinks.
- F. Installation of floor pans in floor depression with floor pans set flush and finished watertight around entire perimeter at juncture with floor surface.
- G. Conduit for refrigeration lines (PVC if embedded in concrete or smooth aluminum if exposed) with 24" radius sweep bends including sleeves any through walls, floors and ceiling.

#### 1.7 WORK BY THE ROOFING TRADE

- A. Roof penetrations properly sealed and flashed to prevent water penetration.

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1.8 BIDDING INSTRUCTIONS AND QUALIFICATION OF BIDDER

- A. The primary items of food service equipment described in this specification are considered the basis of the bid. Only "equal" items listed as part of this specification will be considered and must meet the conditions of the base bid item; this shall include all materials and material finishes, fabrication methods, electrical, plumbing, and mechanical components, electrical control devices, hardware, accessories and options, exactly as specified without exception. It will be the full and complete responsibility of the Food Service Equipment Contractor to pay any and all costs incurred in adapting any other "equal" item to the mechanical, electrical, exhaust ventilation or structural systems of the building including any other cost increase incurred as a result of engineering changes to the mechanical, electrical, exhaust ventilation, architectural, structural or food service drawings. The contract is to be awarded as follows:
1. The competence and responsibility of the bidder.
  2. An itemized cost breakdown of each scheduled item of food service equipment is required, as specified, in order that the District may, at his option, delete any item or supply any portion thereof, or increase the quantity of any item without affecting the cost quoted for the remaining items. "Pre-approved" substituted items must be submitted as an add or deduct alternate in addition to the base bid.
  3. The District is not obligated to accept the lowest or any other bid. The award of the contract and choice of the food service equipment Contractor shall be at the District's discretion.
- B. Each bidder shall be responsible to visit the project site of the proposed work and fully acquaint himself with conditions as they exist.
- C. Each bidder is responsible to attend any pre-bid meeting as required by the District.
- D. Each bidder shall be responsible to examine and review the contract document drawings and specifications. Should the bidder find during examination of the drawings and specifications any discrepancies, omissions, ambiguities, or conflicts in or among the contract documents or shall be in doubt as to their meaning, the District shall be notified no later than four working days prior to bid opening for clarification.
- E. The failure or omission by any bidder to receive or examine any form, instrument or document or to visit the project site shall in no way relieve him from obligation with respect to his bid. No claims for any extras will be allowed due to unintentional errors, conflicts, or omissions in the contract documents drawings or specifications.

1.9 SUBMITTALS

- A. Product Data: For each buy-out item of food service equipment indicated. Include manufacturer's model number and accessories and requirements for access and maintenance clearances, water and drainage, power or fuel and service connections including roughing-in dimensions

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- B. Shop Drawings: For food service equipment not manufactured as standard production and catalog items by manufacturers. Shop drawings shall include the following information:
  - 1. Dimensioned rough-in plans scaled at 1/4"=1'-0" accurately locating connection points and indicating utility data for all mechanical, electrical and supply and exhaust ventilation requirements.
  - 2. Dimensioned plans scaled at 1/2"=1'-0" accurately locating and indicating the finished size of masonry bases, floor depressions in structural slabs, stub walls, curbs and finished openings for pass-thru equipment.
  - 3. Dimensioned plans scaled at 1/4"=1'-0" accurately locating conduit and pull boxes for beverage and refrigeration lines including floor, wall and ceiling penetrations and termination points.
  - 4. Dimensioned plans and detailed drawings of all custom fabricated food service equipment scaled at 3/4"-1'-0" for plan and elevation views and 1-1/2"=1'-0" for sectional views.
- C. Copies of original maintenance and repair manuals including a list of all authorized service agencies responsible for each item of food service equipment.

#### 1.10 QUALITY ASSURANCE

- A. Manufacturer's qualifications shall include a firm that has regularly engaged in the manufacturing of food service equipment of the same type, capacity, performance and size as specified and whose products have been in similar service for not less than five years.
- B. Custom fabricator qualifications for custom food service equipment shall include a skilled sheet metal shop with a minimum of five years' experience in custom sheet metal food service equipment fabrication of similar type as specified. All custom food service equipment shall be fabricated at the same shop.
- C. Installer's qualifications shall include a firm with at least three years of successful installation experience on projects with a similar scope to that as required for this project.
- D. Food service equipment dealers' qualifications shall include a firm which is regularly engaged in the purchasing of food service equipment as is a manufacturer authorized agent of the specified equipment for not less than five years. The dealer shall also employ a full time project management staff to oversee the purchase of the equipment in compliance with the specifications, coordinate the form and fit of the equipment to the project site conditions, attend all project meetings, coordinate shop drawing review, coordinate installation with the Trades, coordinate factory training and address all issues as they relate to the satisfactory completion of the facility in compliance with the specifications and related documentation.
- E. Codes and Standards: All food service equipment furnished and installed under this specification shall be manufactured in strict compliance with the following publications or the current or revised related publication as well as all state, national and local codes and agencies having jurisdiction over same:

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1. National Electrical Manufacturer Association NEMA
    - a. ICS-77 Industrial Controls and Systems
  2. National Electrical Manufacturer Association NEMA
    - a. ICS-77 Industrial Controls and Systems
    - b. 17.4 Local Application System
    - c. 17.13 Water Sprinkler Systems
    - d. 96-76 Installation of Equipment for the Removal of Smoke and Grease Laden Vapors for Commercial Cooking Equipment
  3. National Sanitation Foundation NSF
    - a. 11 76 Food Service Equipment
    - b. 4 73 Commercial Cooking and Warming Equipment
    - c. C-2-72 Special Equipment and/or Devices
  4. National Electrical Manufacturer Association NEMA
    - a. 57-78 Electric Lighting Fixtures
    - b. 197-78 Commercial Electric Cooking Appliances
    - c. 300 Fire Extinguishing Systems
- F. All food service equipment shall be manufactured in strict compliance with standards as set forth by the National Sanitation Foundation (NSF) including fabrication of custom-built equipment and shall be listed with same and shall bear their seal. Any item of food service equipment lacking the NSF seal will be rejected.
- G. All electrically operated food service equipment shall be constructed in strict compliance with standards as set forth by the Underwriters Laboratories (UL) and shall utilize approved components and assemblies and shall bear the label thereof.
- H. Custom fabricated food service equipment shall be constructed to the standards as set forth by the National Association of Food Equipment Manufacturers (NAFEM).
- I. All refrigeration equipment and all pressurized vessels shall be constructed, approved, inspected, registered and stamped and installed in strict compliance with the American Society of Mechanical Engineers (ASME), state and local codes for Unfired Pressure Vessels and all other agencies having jurisdiction thereof.
- J. All gas operated food service equipment shall be fabricated in strict compliance with standards as set forth by the Underwriter Laboratory (UL) and shall be listed with same and shall bear their seal.
- K. Steam operated equipment shall be fabricated and installed in accordance with Pennsylvania Department of Labor and Industry standards.
- L. Product Options: Drawings indicate food service equipment based on the specific products indicated. Other manufacturers' equipment with equivalent size and performance characteristics may be considered.
- M. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings." Review methods and procedures related to food service equipment including, but not limited to the following:
1. Review access requirements for equipment delivery.
  2. Review equipment storage and security requirements.

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3. Inspect and discuss condition of substrate and other preparatory work performed by other Trades.
4. Review structural loading limitations.
5. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment and facilities needed to make progress and avoid delays.

1.11 DELIVERY, STORAGE AND HANDLING

- A. Deliver food service equipment as factory-assembled units with protective crating and covering.
- B. Store food service equipment in original protective crating and covering and in a dry location.

1.12 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions of food service equipment installation areas by field measurements before equipment fabrication and indicate measurements on Shop Drawings and Coordination Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.13 COORDINATION

- A. Coordinate equipment layout and installation with other work including light fixtures, HVAC equipment and fire-suppression system components.
- B. Coordinate location and requirements of service-utility connections.
- C. Coordinate size, location and requirements of concrete bases, positive slopes to drains, floor depressions and insulated floors. Concrete, reinforcement and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete".
- D. Coordinate installation of roof curbs, equipment supports and roof penetrations, as specified in Division 7 Section "Roof Accessories".

1.14 WARRANTIES

- A. General Warranty: The special warranty specified in this Article shall not deprive the District of other rights the District may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.
- B. All buy-out food service equipment herein specified shall have all parts and labor warranted in writing, from the date of Final Acceptance by the District against defective parts, materials, workmanship and design for a period of time as stated within the manufacturers standard published warranty, but no less than two years.



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- C. All custom fabricated food service equipment shall be warranted as stated above except for a period of two years.
- D. Refrigeration equipment shall include start-up and two-year parts and labor warranty on the entire refrigeration system and manufacturers five-year parts warranty on hermetic scroll and semi-hermetic sealed compressors.

## PART 2 - PRODUCTS

### 2.1 MATERIALS AND WORKMANSHIP

- A. Stainless steel shall be type 302 or type 304 extra low carbon non-magnetic austenitic 18% chrome, 8% nickel alloy steel. Gauges shall be U.S. Standard of Thickness set forth below:

GAUGE	THICKNESS	GAUGE	THICKNESS
10	.1346	16	.0598
11	.1196	18	.0478
12	.1046	20	.0359
14	.0747	22	.0299

- B. All sheets shall be of maximum length to permit fabrication from one sheet. All thickness must meet the above gauge thickness within tolerances set forth by the ANSI after polishing. Finished sheets exceeding these tolerances shall be rejected as not meeting this Specification.
- C. Galvanealled steel shall be ARMCO steel or an approved grade of copper bearing steel shall be properly primed, degreased and finished with two coats of synthetic aluminum bronze.
- D. Structural steel members used for framing, consisting of angles, bands, bars and channels shall be ductile in quality, free of hard spots, runs, checks, cracks and other surface defects and shall be smooth galvanized by the hot dip process with all surplus removed, free of runs, blisters, excess splatter and uncoated spots or patches.
- E. White metal shall consist of corrosion resistant metal containing not less than 21% nickel. All castings shall be rough ground, polished and buffed to a bright luster and shall be free from pit marks, runs, checks, burrs and other imperfections.
- F. Stainless steel pipe and tubing shall be seamless or welded of gauge specified and of true roundness. Seamless tubing shall be thoroughly and correctly annealed and ground smooth. Welded tubing shall be thoroughly heat treated and properly quenched to eliminate carbide precipitation, drawn true to size and roundness and polished to match stainless steel sheets.

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- G. Welding shall be of the electric submerged or concealed arc type, heliarc wherever practical. Where welding rods are required they shall be of the same composition as materials to be joined coated with a non-carbonaceous flux.
- H. Plastic Laminate: Complying with NEMA LD 3 and NSF 35 requirements; NSF certified for end-use application indicated; 0.050 inch (1.27 mm) thick, smooth texture and easily cleanable.
  - 1. Color: As selected by Architect from manufacturer's full range of colors.
  - I. Plywood and Lumber: Close grain exterior grade mahogany or birch plywood.
- J. Sealant: ASTM C 920; Type S, Grade NS, Class 25, Use NT. Provide elastomeric sealant NSF certified for end-use application indicated. Provide sealant that when cured and washed meets requirements of Food and Drug Administration's 21 CFR, Section 177.2600 for use in areas that come in contact with food.
  - 1. Color: As selected by Architect from manufacturer's full range of colors.
  - 2. Backer Rod: Closed-cell polyethylene in diameter larger than joint width.
- K. Plastic: Except for plastic laminate, provide plastic materials and components complying with NSF 51.
- L. Sound Dampening: NSF-certified, non-absorbent, hard drying, sound-deadening coating. Provide coating compounded for permanent adhesion to metal in 1/8-inch (3- mm) thickness that does not chip, flake or blister.
- M. Gaskets: NSF certified for end-use application indicated; of resilient rubber, neoprene or PVC that is nontoxic, stable, odorless, nonabsorbent and unaffected by exposure to foods and cleaning compounds.

## 2.2 ACCESSORIES

- A. Cabinet Hardware: Provide NSF-certified stainless-steel hardware for equipment items as indicated.
- B. Casters: NSF-certified standard-duty stainless-steel swivel stem casters with 5-inch (125-mm) diameter wheels, polyurethane tires with 1-inch (25-mm) tread width and 300-lb (90-kg) load capacity per caster. Provide brakes on 2 casters per unit.

## 2.3 FABRICATION, GENERAL

- A. All welds shall be strong and ductile, nonporous, free of pits and cracks. Parts which are to be welded shall be homogeneous, of a like color and finish to adjoining material. Excess metal and carbide precipitation shall be ground off, finished smooth and polished. Unexposed welds shall be pacified to prevent attrition. Brazed or soldered joints are unacceptable. Where galvanizing has been damaged due to the welding or grinding process, these areas shall be galvawelded to replace finish

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- B. All exposed surfaces of the food service equipment shall be free from bolts, screws and rivet fastenings. Wherever bolts are required they shall be of similar composition and finish as the metal to which they are applied.
- C. Wherever practical all food service equipment and fixtures shall be factory or shop fabricated of one-piece construction, shipped to the project site as one unit completely assembled.
- D. Items of food service equipment or fixtures too large to enter or transverse the building to the installation location in one assembly shall be constructed in sections and shall be furnished with field joints. Where field joints are necessary, all adjoining exposed surfaces shall be field welded at the project site as specified above for welding. Where conditions make welded field joints impractical, each sub-assembly shall be fabricated with off-set draw angles welded to the underside of each adjoining top surface and drawn together to a "hairline" seam with 1/4"-20 stainless steel bolts with lock washers and chrome plated acorn nuts. Bolted field joints will be permitted only where specifically shown on Drawings or specified for a particular item.
- E. Wherever shear edges occur they shall be free of burrs, fins or irregular projections and shall be finished to prevent cutting or laceration when the hand is drawn over such shear edges. Brake bends shall be free of undue and where such bends do mar the uniform surface appearance of the material, such marks shall be removed by suitable grinding, polishing and finishing. In no case where miters or bullnose corners occur is overlapping materials acceptable.

## 2.4 GENERAL FRABRICATION STANDARDS

### A. TOPS:

- 1. Tops shall be fabricated of 14-gauge stainless steel unless otherwise specified. All edges shall be bullnose or formed as specified with all joints butt-edged and electrically welded, ground smooth and polished so no evidence of welding will appear. Soldered corners to achieve round corner construction will not be accepted.
- 2. Tops adjacent to walls, columns or other equipment shall be turned up integrally into a backsplash as specified. All interior corners shall be coved on a  $\frac{3}{4}$ " radius, both horizontally and vertically, forming spherical corners. Ends of backsplashes shall be fully enclosed to the low point of the top edge, fully welded, ground smooth and polished.

### B. SUPPORT FRAMING

- 1. Around the entire perimeter on the underside of all tops and set back 1" from the down-turned edge shall be a fully welded frame assembly fabricated of 1-1/2" x 1-1/2" x 1/8" stainless steel angle iron or material as specified. Provide intermediate cross bracing fabricated of the same material as the angle framing and fully weld to perimeter frame on centers not to exceed 24". Tack weld the entire frame assembly to the underside of the top surface.
- 2. Open base tables shall be provided with leg mounting channels for weld anchoring leg gussets and shall be fabricated of 1" x 4" x 1" 12-gauge stainless

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steel or material as specified fully welded at each end of frame and at intervals not to exceed 6'-0".

3. Cabinet base tables and counters shall be provided with triangular corner gusset plates for weld anchoring counter type legs and shall be fabricated of 12-gauge stainless steel fully welded at each corner of table or counter body and at intervals not to exceed 6'-0".
4. Freestanding sinks and Bain Maries shall be provided with triangular corner gusset plates for weld anchoring leg gussets and shall be fabricated of 12-gauge stainless steel, fully welded at each corner of sink or Bain Marie bottom and at intervals not to exceed 6'-0".

C. LEGS AND ADJUSTABLE BULLET FEET

1. Legs shall be constructed of 1-5/8" diameter 16-gauge stainless steel tubing. Each leg shall be swaged and tapered at the bottom. Fasten each leg to a 3-1/2" high conical shaped die-formed stainless steel gusset equivalent to Component Hardware A20-0206. Provide each leg with stainless steel adjustable foot insert equivalent to Component Hardware A10-0852.
2. Cabinet base tables and counters shall be provided with 6" high conical shaped die-formed stainless steel equipment leg with stainless steel adjustable round foot insert equivalent to Component Hardware A72-0811.

D. CROSSRAILS

1. Provide all open base tables and freestanding sinks and bain Maries with 1-1/4" diameter 16-gauge stainless steel tubular cross railing running between legs at a point 10" above the finished floor. Cross railing shall be continuously welded to legs, filleted, ground smooth and polished to provide a smooth coved radius with leg surface.
2. Where cross railing abuts cabinet base fixtures, cross railing shall be concealed bolt anchored to same utilizing stainless-steel hardware.

E. UNDERSHELVES

1. Provide solid fixed undershelf, constructed of 16-gauge stainless steel. Front edge shall be turned down 1" at 90 degrees and returned 1/2" at 45 degrees. Rear and ends shall be turned up 2" high on a 90-degree angle, interior corners coved on 3/4" radius.

F. DRAWERS

1. Provide drawer pan constructed of 14-gauge stainless steel with inside corners coved on a 3/4" radius. Drawer front face shall be double pan type constructed of 16-gauge stainless steel with inner pan set into outer pan and welded in place. Drawer front shall be set into and shall be removable from a 14-gauge stainless steel, channel shaped drawer cradle. Drawer suspension slides shall be secured to drawer frame assembly and shall be Component Hardware S52 series full extension type with 14-gauge stainless steel slides with stainless steel ball bearing wheels having a load capacity of 200 pounds. Provide hard rubber bumper drawer stops. Drawer suspension guides shall be fastened to 18-gauge stainless steel housing which is suspended from the angle framing under the

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- table top. Provide drawer fronts with full grip recessed stainless steel flush pull handles.
2. Stainless steel drawer enclosure cabinet with quantity of drawers as specified with cabinet body fabricated of 18-gauge stainless steel, wrap around construction. The backs of front stiles shall be closed with tight fitting channel sections of 18-gauge stainless steel, welded in place, and closed on top and bottom. Drawer suspension slides shall be secured to drawer frame assembly and shall be Component Hardware S52 series full extension type with 14-gauge stainless steel slides with stainless steel ball bearing wheels having a load capacity of 200 pounds. Provide hard rubber bumper drawer stops. Provide drawer fronts with full grip recessed stainless steel flush pull handles.

G. CABINET BASES

1. Cabinet body shall be fabricated of 18-gauge stainless steel wrap around construction. The backs of front stiles shall be closed with tight fitting channel sections of 18-gauge stainless steel, welded in place and closed on top and bottom.
2. Cabinet base shelves shall be fixed bottom and intermediate fabricated of 18- gauge stainless steel. Front edge shall be turned down 1 1/2" at 90 degrees, returned 1/2" at 90 degrees. Rear and ends shall be turned up 2" at 90 degrees with interior corners coved on a 3/4" radius. Shelf shall be weld anchored to cabinet body. Bottom shelf shall be fabricated flush with front mullions with fully welded facing junctures presenting seamless construction. Fixed intermediate shelves shall be designed similar to bottom shelf except front edge shall be set behind vertical mullions and fully welded thereto.

H. SLIDING DOORS

1. Sliding doors shall be double pan type constructed of 16-gauge stainless steel with inner pan set into outer pan and welded in place. Doors shall have welded internally 1" x 4" x 1" 14-gauge stainless steel hat type reinforcing channels. Doors shall be fitted with full grip, recessed type stainless steel flush pull handles. Provide 16-gauge stainless steel angle door stops welded to door. Provide hard rubber door stops. Provide each door with two, 1 3/8" diameter stainless steel ball bearing sheaves fastened to 1" x 1/8" thick stainless-steel bar stock hangers welded to top corners of each door for suspending on overhead door channel track. Provide hangers with stainless steel removable locks to prevent doors from jumping track during operation while permitting ease of removal. Fabricate overhead track of 14-gauge stainless steel and weld to cabinet body. Provide bottom of doors with nylon door guides secured to bottom shelf. Guides shall not interfere with door removal.

I. HINGED DOORS

1. Hinged doors shall be double pan type constructed of 16-gauge stainless steel with inner pan set into outer pan and welded in place. Hinges shall be stainless steel cam action pin type fastened by means of counter sunk flat head stainless steel screws staggered on centers and tapped into 1/4" thick stainless-steel bar stock welded behind door jamb. Doors shall be removable from hinges without the use of tools. Doors shall be held closed by permanent magnet closure

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devices. Doors shall be fitted with a full grip recessed type stainless steel flush pull handle. Provide hard rubber door stop bumpers.

J. SINKS

1. Sinks shall be fabricated of 14-gauge stainless steel with all interior corners coved on a  $\frac{3}{4}$ " radius both horizontally and vertically forming spherical corners.
2. Exposed edges of sink shall be finished with a 1  $\frac{1}{2}$ " diameter 180 degree rolled edge, rear and sides adjacent to adjoining surfaces shall have a backsplash turned up 10" high at a 90-degree angle on a  $\frac{3}{4}$ " radius and turned back 2  $\frac{1}{2}$ " on a 45-degree angle, then down  $\frac{1}{2}$ " at 90 degrees along back.
3. Multiple sink compartments shall be divided with double wall 14-gauge stainless steel partitions 1" wide rounded on top and all corners at a  $\frac{3}{4}$ " radius. Finish bottom, back and front with 14-gauge stainless steel to form one continuous sink with no overlapping joints or open spaces between sink compartments.
4. Integral drainboards shall be constructed of 14-gauge stainless steel. The front portion shall continue the 1  $\frac{1}{2}$ " diameter 180 degree rolled rim of the sink bowl on a continuous level horizontal plane. The surface of the drainboard shall be pitched from 2  $\frac{1}{2}$ " at the end away from the sink to 3" at the sink bowl. Sink and drainboard backsplash shall be continuous and level on the horizontal plane. All interior corners both vertical and horizontal shall be coved on a  $\frac{3}{4}$ " radius. Drainboards shall be reinforced with 1" x 4" x 1", 12-gauge stainless steel "hat" channels extending front to rear tack welded to underside of drainboard for weld anchoring leg gussets.
5. Provide crossrails extending front to rear between legs, crossrails shall not extend along rear at sink to prevent interference with plumbing.
6. Built-in sink compartments shall be fabricated as an integral part of fixture with sink fully welded with adjacent top, weld ground smooth and polished.

K. MILLWORK

1. Millwork fabricator shop shall be a certified participant in AWI's Quality Certification Program (QCP) to standard "Premium" construction.
2. Tops shall be fabricated of  $\frac{3}{4}$ " thick 5-7 ply BW marine grade plywood build up to a 1  $\frac{1}{2}$ " thickness. All plastic laminate finished edges shall be applied prior to the surface laminate. Provide cross bracing around entire perimeter below tops and above all interior dividers to minimize deflection from equipment. Tops shall be fabricated in sections as large as possible to minimize field seams. Field seams shall be assembled utilizing TB-2 yellow glue. The bottom surfaces of all tops must be sealed with gray cabinet liner to comply with Board of Health requirements. Cut-outs for drop-in equipment shall be cut in the shop and with all edges sealed. All drop-in equipment shall be pre-fitted in top prior to delivery to the job site. All drop-in equipment shall be sealed with General Electric or equivalent clear silicon sealer after installation. Hardwood edges shall be applied prior to surface laminate. All hardwood to match for color and grain. Edges to be chamfered and finished as specified. Solid surface tops shall receive full plywood substrate with  $\frac{3}{4}$ " x 3" batons for proper air space. All tops shall be prepared for installation of sneeze guards including additional blocking and / or cutouts.
3. All cabinet base and interiors shall be fabricated of  $\frac{3}{4}$ " thick 5-7 ply marine grade plywood with high-pressure laminate finish. Recessed toe base shall be 6"

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high fabricated of 3/4" thick 5-7 ply marine grade plywood with 16-gauge stainless steel finish. Shelf pilasters to be recessed type 250WH with 253WH locking clips. Cabinet backs shall be fabricated of 1/4" thick MELA-MDF board. Cabinet ends to be dadoed for back and bottom and notched to receive aprons and kicks. Butt or dowel construction will not be acceptable. Cabinets shall be assembled with TB-2 yellow glue with screws and staples. Cabinets with finished backs shall be fabricated of 3/4" thick 5-7 marine grade plywood with high-pressure laminate finish. Cabinets over 48" in length shall have interior dividers. Dividers shall be dadoed into the bottom and notched for aprons. Dividers shall be notched as required for equipment. Aprons shall be large enough to conceal drop-in equipment and also to house control panels. Cabinet bases shall be fabricated in sections as large as possible to minimize field seams.

4. Doors shall be fabricated of 3/4" thick MDF board with high-pressure laminate finish and shall be furnished with three BLUM 75M5580 or 75M5680 European style concealed hinges. Door pulls shall be Hafele 116.39.437. Locks where required shall be cam style, keyed alike. Doors shall not exceed 27" in width and shall be of equal size.
5. Drawers shall be constructed of 3/8" thick birchwood with dove tail joinery. Drawer slides shall be Accuride 150 lb. full extension type with stainless steel ball bearing hardware.
6. Applied wood fascia panels and doors shall be stile and rail design. Panels to be recessed or raised as specified. All wood to be select for color and grain. Finish shall match stock color samples or custom to match furnished sample. All panels and doors to be equally sized per cabinet. Provide full wood louvered panels as required for equipment requiring air circulation. Finish all wood with stain followed by single coat of sealer. After sealer, apply one layer of Armourcote conversion varnish approved for use in food service with 55% gloss.

L. SOLID AND HARD SURFACE MATERIAL ("CORIAN" / "ZODIAQ")

1. Provide counter top, tray slide, etc. of approved solid surface material. Material shall be fabricated and assembled per manufacturers approved methods utilizing a factory authorized and certified fabricator and installer. The edges of the top shall be formed as indicated on the food service and architectural detail drawings, routed and finished as directed. Openings shall have radius corners and shall be reinforced with additional material. Where drop-in appliances are to set on tops, the fixture shall be furnished with a 3/4" thick marine grade plywood sub-top fabricated with a perimeter frame extending through the opening in the top preventing the appliance from setting directly on the solid surface material and allowing the sub-top to distribute the weight of the appliance. Where heated appliances are to set on the top the sub-top is to be fabricated as above to prevent heat from being in direct contact with the solid surface top; additional fiberboard insulation material is to be provided where transfer of radiated heat will contact any solid surface material

M. PAINTING

1. Galvanized steel shall be cleaned and degreased with mineral spirits, primed with a minimum of two coats of primer and spray finished with a minimum of two coats of gray epoxy enamel paint

N. LAMINATED PLASTIC

1. All exposed surfaces shall be faced with 1/16" thick high-pressure plastic laminate in color and pattern as specified.

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2. All unexposed surfaces shall be faced with .020 or .030 gray thermoset decorative overlay.
3. Where the plastic laminate is to be bonded to removable or fixed panels the panels shall be fabricated of 3/4" thick close grain marine grade mahogany or birch plywood with surfaces bonded with waterproof glue.
4. Where the plastic laminate is to be bonded directly to the metal facing of a cabinet base table or counter, surfaces shall be bonded with contact adhesive.

O. CLOSURE TRIM

1. Provide closure trim pieces fabricated of 16-gauge stainless steel or of material and finish as specified, trim shall be one-piece constructions furnished to seal both horizontal and vertical junctures and openings

2.5 STAINLESS STEEL FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal products" for recommendations relative to applying and designating finishes.
  1. Remove or blend tool and die marks and stretch lines into finish.
  2. Grind and polish surfaces to produce uniform directional textured polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.
- B. Concealed Surfaces: Minimum of 80 grit finish.
- C. Exposed Surfaces: No. 4 finish (bright, directional polish) of 180 grit.
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- E. Protect mechanical finishes on exposed surfaces from damage by applying a strippable temporary protective covering before shipment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions with Installer for compliance with requirements for installation tolerances, service-utility connections and other conditions affecting installation and performance of food service equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine roughing-in for piping, mechanical and electrical systems to verify actual locations of connections before installation

3.2 INSTALLATION

- A. Set each item of fixed food service equipment securely in place, level and adjust to correct height. Anchor to supporting surface where required for sustained operation and use without shifting or dislocation. Provide concealed anchoring where possible. Adjust work surfaces to a level



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tolerance of 1/16" maximum offset and slope drainage surfaces at 1/16" per foot.

- B. Complete field assembly of field joints by welding or bolting utilizing the method as indicated with the fixture. Grind all field welds smooth and polish. Set and trim all gaskets to be installed as part of field assembly.
- C. Treat enclosed spaces that are inaccessible after food service equipment installation by covering all horizontal surfaces with powdered borax at a rate of 4 ounces per square foot.
- D. Provide closure trim pieces fabricated of 16-gauge stainless steel or of material and finish as specified, trim shall be one-piece construction furnished to seal both horizontal and vertical junctures and openings where the conditions given below occur:
  - 1. Food service equipment is installed into wall openings. Trim shall apply to both sides of wall opening with all corners fully welded, ground smooth and polished.
  - 2. Two or more items of food service equipment are butted together.
  - 3. Food service equipment is installed against wall, columns other equipment resulting in a gap or juncture exceeding 1/4" in width.
  - 4. An open gap of any size between the juncture or joint between adjoining items of food service equipment, wall or column surfaces which might result in the penetration or collection of grease or vermin.
- E. Provide cut-outs and openings in food service equipment as required to extend plumbing, electric, steam or gas lines through the food service equipment either for interconnection of utility lines or final connection.
- F. Seal around each item of food service equipment with sealant for gaps or spaces less than 1/4" in width and with stainless steel trim for gaps or spaces exceeding 1/4" in width. Closure strips shall conform to the shape and size of the surfaces or juncture to be sealed and shall be neatly scribed for a tight fit.

### 3.3 PROTECTION AND CLEANING

- A. Provide final protection and maintain conditions in a manner acceptable to District, Manufacturer and Installer that ensure food service equipment is without damage or deterioration at the time of Substantial Completion.
- B. After completion of the food service equipment installation and completion of other major work in the food service area remove protective coverings and clean and sanitize all food service equipment both internally and externally. Restore exposed and semi- exposed finished to remove abrasions or other surface damage, polish exposed metal surfaces and touch-up painted surfaces. Replace work which cannot be successfully restored.

### 3.4 COMMISIONING

- A. Delay start-up of the food service equipment until utility services have been installed, completed and tested, balanced and adjusted for pressure and voltage, and until water and steam lines have been treated and cleaned for sanitation. Before start-up of the food service equipment lubricate in accordance with manufacturer's instructions.

- 1. Coordinate food service equipment startup with service-utility testing, balancing and

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adjustments. Do not operate steam lines before they have been cleaned and sanitized.

- B. Provide on-site demonstration and formal technical training by the manufacturer's technical representative for each item of food service equipment as required to instruct the District and its personnel in the safe operation and sanitation and maintenance of the food service equipment.
- C. Test each item of food service equipment for proper operation.
  - 1. Repair or replace equipment that is defective in operation including units that operate below required capacity or that operate with excessive noise or vibration.
  - 2. Test refrigeration equipment's ability to maintain specified operating temperature under heavy-use conditions. Repair or replace equipment that does not maintain specified operating temperature.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 4. Test motors and rotating equipment for proper rotation and lubricate moving parts according to manufacturer's written instructions.
  - 5. Test water, drain, gas, steam, oil, refrigerant and liquid-carrying components for leaks. Repair or replace leaking components.
  - 6. Train District's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing and preventive maintenance for each food service equipment item.
  - 7. Review data in the operation and maintenance manuals. Refer to Division 1 Section "Contract Closeout".
  - 8. Review data in the operation and maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data".
  - 9. Schedule training with District through Construction Manager with at least seven days advance notice.

### 3.5 SCHEDULE OF EQUIPMENT

- A. Equipment Schedule: Refer to all Contract Documents pertaining to the food service areas. Equipment itemized along with brands and model numbers and salient features establish the standard for construction, operation and engineering criteria.
- B. Equipment indicated below is intended to establish the standard of quality of the food service equipment. Alternate "Equal" products by other manufacturers may be considered if equivalent in design, performance, durability and function.
- C. This document is the intellectual property of Corsi Associates and as such use by any other entity is prohibited.

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ITEM #01                      WALK-IN COOLER/FREEZER COMBINATION  
Quantity:                    One (1) Manufacturer:  
                                     Bally / Kolpak / Arctic  
Model:                        Size and shape as per plan  
Construction:                Furnish and erect compartment sectional urethane insulated walk-in cooler / freezer assembly.

Walk-in assembly shall bear the UL and NSF label and shall meet 2009 Federal Regulations.

Ceiling and wall panels shall be constructed of 4" thick urethane insulation, assembly to be accomplished by the use of integral cam type locking device secured in place during the foaming process. Seams between panels shall be fully insulated with vinyl foamed-in-place gasket material.

Ceiling and wall panels shall be finished of 18 gauge embossed aluminum on interior and exterior surfaces.

Walk-in assembly shall be provided with 1/8" thick aluminum diamond tread plate floor with NSF approved coved corners, insulated with 4" thick urethane insulation and reinforced with 3/4" thick 5-7 ply marine grade plywood underlayment. Floor installation shall be in accordance with manufacturer's recommended practice and shall sit in building floor depression. Building floor finish shall be flush and smooth to allow a level transition between the walk-in floor and the adjacent finished kitchen floor.

Walk-in assembly shall be furnished with 36" wide in-fitting type door and frame assemblies constructed of 16 gauge stainless steel provided with three self-closing cam action chrome plated hinge assemblies, handles and hardware.

Provide each door with 2" dial type flush mount thermometer with chrome plated bezel mounted in door frame.

Provide each door with triple pane observation and 36" high x 1/8" thick aluminum diamond tread kick plates on both interior and exterior side.

Provide each door with UL listed vapor-proof LED light fixture complete with toggle switch and pilot light and full perimeter frame condensation heater.

Provide four (4) additional UL listed vapor-proof LED ceiling mounted light fixtures complete with stainless steel mounting hardware. One (1) in freezer section and one (3) in cooler section.

Foodservice Equipment Contractor shall install ceiling mounted light fixtures and furnish materials and inter-wire light fixtures and switch.

Walk-in freezer assembly shall be furnished with heated pressure relief port.

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Furnish and install 18 gauge embossed aluminum vertical trim angles and ceiling closure panels.

Furnish and install entire refrigeration system complete with Copeland semi-hermetic condensing units and insulated copper refrigeration lines charged with R448A refrigerant. Each condensing unit shall be interconnected to a low profile, high velocity evaporator coil in each walk-in compartment. Refrigeration system shall include all fittings, valves, switches, controls and all related components to comprise a complete operating unit of sufficient BTU capacity to maintain automatic operation of 35 degree F product temperature in cooler and -10 degree F product temperature in freezer.

Refrigeration system shall be provided with outdoor remote air cooled condensing units with each condensing unit to be located outdoors on the building roof.

Condensing units shall be provided with winterized controls (low ambient package) including crankcase heater, head pressure control, dryers and galvanized steel stand with hinged louvered weather hood.

Provide all hangers and brackets as required to install refrigeration lines.

Construction Trade shall furnish all sleeves and openings through walls for passage of refrigeration lines.

Secure condensing unit stands to building roof; Roofing Trade shall provide waterproof roof opening for passage of refrigeration lines.

Foodservice Equipment Contractor shall furnish materials and inter-wire defrost time clock circuit for walk-in freezer, from condensing unit to evaporator coil.

Foodservice Equipment Contractor shall furnish materials and install (wrap and insulate with foam pipe insulation) heat tracing tape to evaporator coil condensate line in walk-in freezer.

Foodservice Equipment Contractor shall furnish and install copper tubing and extend evaporator coil condensate line to floor receptacle.

Set and adjust all temperature and defrost cycles.

Provide start-up and two year material and labor warranty on entire refrigeration system and five years manufacturer's warranty on compressor.

ITEM #02 EVAPORATOR, WALK-IN COOLER

Quantity: One (1) Manufacturer:  
Bally / Kolpak / Arctic

Model: Custom

Remarks: Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

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ITEM #03                    CONDENSING UNIT, WALK-IN COOLER  
Quantity:                One (1) Manufacturer:  
                              Bally / Kolpak / Arctic  
Model:                    Custom  
Remarks:                Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

ITEM #04                    EVAPORATOR, WALK-IN FREEZER  
Quantity:                One (1) Manufacturer:  
                              Bally / Kolpak / Arctic  
Model:                    Custom  
Remarks:                Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

ITEM #05                    CONDENSING UNIT, WALK-IN FREEZER  
Quantity:                One (1) Manufacturer:  
                              Bally / Kolpak / Arctic  
Model:                    Custom  
Remarks:                Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

ITEM #06                    PLASTIC WITH METAL FRAME SHELVING  
Quantity:                One (1) Manufacturer:  
                              Metro / Eagle Group  
Model:                    Super Erecta Pro  
Options:                  PR2454NK3 Shelves (4)  
                              63UPK3 Posts (4)  
                              5MP Casters (2)  
                              5MPB Casters with brakes (2)  
Remarks:                Assemble into four tier unit(s) with bottom shelf 12" above finished floor.

ITEM #07                    PLASTIC WITH METAL FRAME SHELVING  
Quantity:                Six (6) Manufacturer:  
                              Metro / Eagle Group  
Model:                    Super Erecta Pro  
Options:                  PR2460NK3 Shelves (24)  
                              63UPK3 Posts (24)  
                              5MP Casters (12)  
                              5MPB Casters with brakes (12)  
Remarks:                Assemble into four tier unit(s) with bottom shelf 12" above finished floor.

ITEM #08                    PLASTIC WITH METAL FRAME SHELVING  
Quantity:                Two (2)  
Manufacturer:            Metro / Eagle Group  
Model:                    Super Erecta Pro  
Options:                  PR2442NK3 Shelves (8)  
                              63UPK3 Posts (8)  
                              5MP Casters (4)  
                              5MPB Casters with brakes (4)

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Remarks: Assemble into four tier unit(s) with bottom shelf 12" above finished floor.

ITEM #09 PLASTIC WITH METAL FRAME SHELVING

Quantity: Two (2)

Manufacturer: Metro / Eagle Group

Model: Super Erecta Pro

Options: PR2448NK3 Shelves (8)

63UPK3 Posts (8)

5MP Casters (4)

5MPB Casters with brakes (4)

Remarks: Assemble into four tier unit(s) with bottom shelf 12" above finished floor.

ITEM #10 DUNNAGE RACK

Quantity: Three (3)

Manufacturer: Cambro / Metro / Eagle Group

Model: DRS600131

Options: DRLNK110 Camlink (3)

ITEM #11 PLASTIC WITH METAL FRAME SHELVING

Quantity: Three (3)

Manufacturer: Metro / Eagle Group

Model: Super Erecta Pro

Options: PR2454NK3 Shelves (15)

74UPK3 Posts (12)

5MP Casters (6)

5MPB Casters with brakes (6)

Remarks: Assemble into five tier unit(s) with bottom shelf 12" above finished floor.

ITEM #12 HIGH DENSITY SHELVING SYSTEM, TOP TRACK, 5 TIER

Quantity: One (1) Manufacturer:

Metro / Eagle Group

Model: TT17-E2460M2460P

Remarks: Top-Track® EZ Order Model, nominal 17 ft. system length x 5 ft. width, consists of (1) 11-1/2 ft. track set, (8) 86" posts, (1) 24" tie bar end kit, (16) 74" Top-Track® mobile posts, (4) 24" mobile kits (stainless steel casters, bumpers, rollers), (24) 24"D x 60"W shelves, Super Erecta Pro polymer/wire shelving, NSF

Equipment per layout FS-1.0.

ITEM #13 CAN RACK SYSTEM

Quantity: One (1) Manufacturer:

Eagle Group / Metro

Model: CRC4

ITEM #14 SPARE NUMBER

ITEM #15 SPARE NUMBER

ITEM #16 WASHER/DRYER, STACKED

Quantity: One (1)

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Sup Info: Not in Foodservice Equipment contract, furnished by the District.

ITEM #17 SPARE NUMBER

ITEM #18 SPARE NUMBER

ITEM #19 SHELF, WALL MOUNT

Quantity: Two (2)

Manufacturer: Eagle Group / John Boos / Advance Tabco

Model: WS12120-14/3

Sup Info: Furnish stainless steel mounting hardware of proper type for wall construction and to sustain weight while in use.

Construction Trade shall provide wall blocking as required for mounting.

ITEM #20 WORK TABLE, STAINLESS STEEL TOP

Quantity: One (1)

Manufacturer: Eagle Group / Advance Tabco / John Boos

Model: T30120SE-BS

Options: E36A Welded base

E59 Undershelf upgrade E22

Sink bowl, weld in (2)

341189 Twist handle drain (2)

-TB bracket (2)

351585 Sink cover (2) E47

Sink cover holder

YCORSI-502971-MOD Drawer (2)

ITEM #21 HAND SINK

Quantity: Three (3)

Manufacturer: Eagle Group / John Boos / Advance Tabco

Model: HSA-10-FAW

Options: 318496 Paper towel dispenser (3)

300602 Soap dispenser (3)

307120 Wrist handles (3)

-LRS Left and right side splashes (3)

Sup Info: Furnish stainless steel mounting hardware of proper type for wall construction and to sustain weight while in use.

Construction Trade shall provide wall blocking as required for mounting.

Foodservice Equipment Contractor to verify soap dispenser and paper towel dispenser type with the Owner.

ITEM #22 TRASH RECEPTACLE

Quantity: Three (3)

Manufacturer: Rubbermaid

Model: FG354060GRAY

Options: FG267360GRAY (3)

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ITEM #23 REACH-IN FREEZER

Quantity: One (1)

Manufacturer: Continental / Victory / True

Model: 1FNSS

Options: Stainless steel interior  
Stainless steel exterior  
Stainless steel case back  
Door hinged on left  
Exterior mounted digital thermometer  
Automatic condensate evaporator  
Swivel casters with polyurethane tires and front locking brakes Plug and cord set  
Two additional shelves

ITEM #24 EXHAUST HOOD

Quantity: One (1)

Manufacturer: Captive Aire / Accurex

Model: Size and shape as per plan

Construction: Furnish and install exhaust hood with integral plenum box make-air system.

Entire exhaust ventilation system shall be constructed in compliance with UL, NSF, NFPA, IMC 2018 (including automatic start-up of the exhaust and supply ventilation upon activation of any cooking appliance) and any prevailing statutes and codes.

Hood shall be 11'-0" long constructed in one section of 18 gauge 304 stainless steel with all seams continuously welded, ground smooth and polished. Hood mounted utility cabinet shall be 1'. Provide a full complement of stainless steel "high efficiency" Captrate Solo baffle type grease extractors.

Furnish remote bulb thermostat with watertight hardware and install in either the exhaust plenum of the hood or in the exhaust duct. Provide NEMA 3 control panel box with hinged front cover complete with supply and exhaust fan contactors wired to an adjustable thermostat control, field wiring terminal strip and on-off switch.

Provide 18 gauge 304 stainless steel supply and exhaust duct collar.

Provide 18 gauge 304 stainless steel insulated supply air plenum box assembly with internal air volume control damper integral along the face of the hood. Mount in finished ceiling along face of hood and furnish full length stainless steel perforated removable panels for discharge of supply air along entire face of hood.

Provide stainless steel threaded hanger rods complete with stainless steel mounting hardware for securing to structural ceiling.

Mechanical (HVAC) Trade shall furnish and install a complete exhaust air handling system including exhaust fan and controller, fan start-stop switch with status lights, 16 gauge insulated welded ductwork from exhaust collar on exhaust hood to fan, hinged roof curb with grease trough and removable grease container.



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Mechanical (HVAC) Trade shall install exhaust hood heat detector(s) in exhaust hoods with multiple exhaust collars in the exhaust duct just after the point of the pant leg juncture; this includes punching of the required hole in the duct and installation of the heat detector and fitting.

Mechanical (HVAC) Trade shall furnish and install a complete supply air handling system including supply fan and controller (with maintainable filter system) and supply air heater with thermostat control (to temper incoming supply air below 65 degree F ambient), fan start-stop switch with indicator lights, galvanized steel ductwork from supply collar on exhaust hood to fan and roof curb.

Electrical Trade shall furnish and install interconnecting wiring between fan motors, controllers and switches.

Electrical Trade shall furnish and install inter-wiring of cooking appliance start-up inter-lock device and the supply and exhaust ventilation system and wire per the manufacturer's instructions and per applicable codes.

Furnish three (3) UL listed vapor-proof recessed LED light fixtures wired to a common on-off switch with stainless steel cover plate located on the wall adjacent to the exhaust ventilator.

Electrical Trade shall furnish materials and inter-wire light fixtures to wall mounted utility cabinet.

Mechanical (HVAC) Trade shall furnish and install INVERTER DUTY THREE PHASE exhaust fan and controller.

Mechanical (HVAC) Trade shall furnish fans set compatible with variable frequency drive specification.

Electrical Trade shall furnish and install Interconnecting wiring of the system between the exhaust hood sensors, remote frequency drive unit and exhaust and supply fan motors.

Furnish and install 18 gauge stainless steel ceiling closure panels extending from the top of the exhaust ventilator to the finished ceiling. Panels shall be removable without the use of tools for access.

Furnish and install 18 gauge 304 stainless steel wall panels extending from the bottom of the rear of the exhaust hood to the upper edge of the base-board molding and extending along the full length of all wall surfaces. Wall panel sections shall be fitted with 1/2" wide off-set seams at intermediate joints to allow panel sections to fit tightly against the wall and to result in watertight seams. Secure wall panels to building wall with wall panel adhesive of proper type for wall construction. Seal end seams with General Electric or equivalent clear silicone sealer.

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Electrical Trade shall provide the inter-wiring between the control enclosure, fire system, supply and exhaust fans and variable frequency drives and duct riser temperature switch.

Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

ITEM #24.1

HOOD CONTROL PANEL

Quantity:

One (1)

Manufacturer:

Captive Aire

Model:

Size and shape per plan

Sup Info:

Furnish 18 gauge stainless steel utility and fire system enclosure cabinet with hinged access doors for both hood and fire system controls and fire suppression tanks. System shall be listed by ETL (UL 508A) NSF, NFPA, IMC 2018 and any prevailing statutes or codes including automatic shut-down of all cooking appliances per code section 44 of NFPA 17-27. Cabinet may be freestanding wall type or integral with exhaust hood as shown on the contract drawings. Furnish stainless steel mounting hardware of proper type for wall construction for wall mounted cabinet.

Furnish and install variable volume motor control center with variable frequency drive, input / output processor and keypad enclosed within a stainless steel utility cabinet for remote mounting. System shall include, but not be limited to, electronic variable volume motor starters with thermal overload, input / output processors, control keypad, temperature and optic sensors and plug and play cables. Temperature sensor shall be mounted in the exhaust duct collar; optic sensor shall be mounted inside the ends of the hood with air purge units mounted on top.

Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

ITEM #24.2

FIRE PROTECTION SYSTEM

Quantity:

One (1)

Manufacturer:

Captive Aire

Model:

TANK

Sup Info:

Furnish and install in exhaust hood, plenum and surface fire protection system.

TANK Fire Suppression is a pre-engineered, stored-pressure wet chemical solution extinguishing system.

TANK Fire Suppression System shall be UL & ULC listed in accordance with UL300, UL1254, ULCORD-C1254.6.

Microprocessor-based control board shall be ETL Listed to UL Standard 864 and CAN/ULC-S527-11.

TANK Fire Suppression System intended for installation and for use in ac-

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cordance with the National Fire Protection Association Standards:

1. Wet Chemical Extinguishing Systems, NFPA 17A
2. National Electrical Code, NFPA 70
3. National Fire Alarm & Signaling Code, NFPA 72

New York City and FDNY approved under COA# 5870.

California State Fire Marshal (CFSM), Listing No. 7085-2199:0502.

A pre-engineered, fixed pipe, automatic wet chemical agent fire suppression system for protection of all hazard areas associated with cooking operations, including exhaust hoods, plenums, ductwork, and cooking appliances.

Exhaust hood fire system components to be factory installed.

#### **Cylinder and Valve Assembly**

1. The cylinders shall have a tin-nickel alloy plated brass valve with pressure gauge.
2. Wet chemical agent shall be contained in one or more stored pressure DOT/TC rated steel cylinder and valve assemblies.
3. Each cylinder is factory-filled with liquid fire suppressant and pressurized to 200 PSIG at 70°F.

#### **Distribution Nozzles**

4. Nozzles shall be located to protect the exhaust ducts, plenums, and all cooking appliances requiring protection.
5. All nozzles shall be equipped with a metal blow off cap. The cap prevents contamination from entering the pipe network and is designed to pop off upon system discharge, allowing agent to flow to the protected hazard area.
6. All nozzles shall incorporate a stamped part number to easily identify nozzle type.

#### **Distribution System**

7. The distribution system shall consist of Copper, Schedule 40 black iron, chrome-plated or stainless-steel pipe and fittings. All exposed piping and fittings must be chrome-plated or stainless steel.
8. Fittings shall be minimum class 150. Galvanized fittings shall not be used.

#### **Suppression System**

9. The system control equipment shall be capable of all functions associated with automatically and manually discharging the wet chemical agent from all cylinder and valve assemblies, including automatic shutdown of the heat source or fuel and electrical power to all protected areas upon system discharge.
10. Liquid Fire Suppressant shall be Aqueous Potassium Carbonate (APC).
11. All mechanical components of the actuator kit shall be enclosed.
12. The actuator kit shall be capable of automatic or manual activation means.

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13. Supervisory Pressure Switch added to monitor operating system pressure.
14. For manual activation, an electrically operated manual release shall be used to actuate the system manually.
15. For automatic activation, the system will be activated by a Firestat (heat) detector.

**Electrical**

16. Electrical Division to provide shunt trip breakers at main power panel, or disconnects, as designated by the Electrical Engineer; interconnection provided at hood control panel for the signal to shut down all electricity in and under the exhaust hood. Shunt trips/disconnects to accomplish shut off of electricity in the event of fire system activation by others.
17. Printed circuit board with microprocessor-based controller that provides all the necessary monitoring, timing, and supervision functions required for the reliable operation of the fire system.
18. Independent supervised loops incorporate redundancy and fault detection.
19. Real-time cloud-based monitoring connection provided with system by ownership.
20. Primary power supply, with battery backup for power loss.
21. All wiring must be in accordance to NFPA 70 and the Authority Having Jurisdiction (AHJ).
22. Electric gas valve provided for equipment below exhaust hood. Coordinate size and installation with Plumbing Division.
23. All wiring is to be in accordance with the applicable manufacturer's instructions for the fire alarm control panel, gas shut-off valve, manual reset relay, and contractor supplied shut-off devices.

As part of this item, provide wall mounted type K handheld portable fire extinguisher, placard, and mounting bracket as required in the immediate vicinity of each cooking area, per NFPA-96 and NFPA-10. Additional fire extinguishers as required in the kitchen area are to be specified by the Architect and provided by the General Contractor.

Inter-wiring of the fire system to the exhaust hood shall be furnished and installed by the Electrical Trade.

Provide as part of fire system, electrically operated gas supply line shut-off valve (two required for "loop" gas service) to interrupt gas supply to all gas operated cooking appliances. Gas valve shall be provided with manual reset to prevent gas flow to pilot devices on appliances prior to restart.

Provide one remote manual pull station to actuate fire system in the event of a fire.

Plumbing Trade shall install gas shut-off valve(s) in gas supply line.

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Electrical Trade shall inter-wire gas shut-off valve(s) to fire system.

Electrical Trade shall furnish and install electric shunt-trip circuit breakers or electric shut-off contactors to interrupt electric power to all electrically operated cooking appliances.

Provide dry contacts in fire system to interface with building fire alarm system as required, electrical tie-in shall be the responsibility of the Electrical Trade.

Provide as part of fire system, start-up testing of the fire system as required by local fire codes. Subsequent testing of the fire system for a period of one year after start-up shall be included as part of this contract.

Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

Install in accordance with manufacturer's instructions, drawings, written specifications, manufacturer's installation manual, and all applicable building codes.

Six-month and twelve-month inspections, servicing, and replacement of components as per NFPA 96 to be provided by the General Contractor or Owner.

Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

ITEM #25

CONVECTION OVEN

Quantity:

One (1)

Manufacturer:

Blodgett / Garland / Vulcan

Model:

DFG-100 DBL

Options:

Solid state thermostat

Mechanical timer

Stainless steel draft diverter

4 1/4" low profile swivel casters with polyurethane tires and front locking brakes

Stainless steel solid back panel Gas manifold

Gas pressure regulator

Dormont 1675KITCF2S48 Gas hose kit

Sup Info:

Foodservice Equipment Contractor shall install disconnect at wall connection and to cooking appliance per manufacturer's instructions.

Foodservice Equipment Contractor shall provide and secure restraining cable between wall and equipment.

ITEM #26

CONVECTION STEAMER, GAS

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Quantity: One (1)  
Manufacturer: Groen / Cleveland / Market Forge  
Model: HY-10SG-24  
Options: Low profile swivel casters with polyurethane tires and front locking brakes  
Stainless steel solid back panel  
Gas manifold  
Gas pressure regulator  
Drain tempering valve  
Dormont 1675KITCF2S48 Gas hose kit  
Dormont W50BP48 Water hose kit (2)

Sup Info: Foodservice Equipment Contractor shall install disconnect at wall connection and to cooking appliance per manufacturer's instructions.

Foodservice Equipment Contractor shall provide and secure restraining cable between wall and equipment.

ITEM #26F WATER FILTRATION SYSTEM FOR CONVECTION STEAMER

Quantity: One (1)  
Manufacturer: Everpure / 3M / Optipure  
Model: EV9797-50  
Options: EV961716 Cartridge EV979902  
Scalestick cartridge  
EV979833 Scalekleen scale remover

Sup Info: Furnish stainless steel mounting hardware of proper type for wall construction and to sustain weight while in use.

General contractor shall provide wall blocking as required for mounting.

Foodservice Equipment Contractor shall install steamer filter system in water supply line and furnish and install interconnecting piping between water filter and steamer water inlet.

ITEM #27 2-BURNER RANGE

Quantity: One (1)  
Manufacturer: Garland / Vulcan / Imperial  
Model: C18-7S  
Options: Stainless steel front and sides  
Stainless steel belly bar, standard  
Backguard flue riser with single high shelf  
Low profile swivel casters with polyurethane tires and front locking brakes  
Stainless steel solid back panel  
3/4" Rear gas connection, including end cap & cover  
Gas manifold  
Gas pressure regulator

Dormont 1675KITCF2S48 Gas hose kit

Sup Info: Foodservice Equipment Contractor shall install disconnect at wall connection and to cooking appliance per manufacturer's instructions.

Foodservice Equipment Contractor shall provide and secure restraining cable  
between wall and equipment.

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ITEM #28	SPARE NUMBER
ITEM #29	SPARE NUMBER
ITEM #30	HEATED CABINET, PASS-THRU
Quantity:	Two (2)
Manufacturer:	Continental / Victory / True
Model:	DL1WI-SS-RT
Options:	Stainless steel interior (2)
	Stainless steel exterior (2)
	Hinging per plan (2)
	Exterior mounted digital thermometer (2)
	Plug and cord set (2)
	Universal pan slide assembly (2)
ITEM #31	REFRIGERATOR, PASS-THRU
Quantity:	Two (2)
Manufacturer:	Continental / Victory / True
Model:	1RNSSPT
Options:	Stainless steel interior (2)
	Stainless steel exterior (2)
	Hinging per plan (2)
	Exterior mounted digital thermometer (2)
	Automatic condensate evaporator (2) Plug and cord set (2)
	Universal pan slide assembly (2)
ITEM #32	WORK TABLE, STAINLESS STEEL TOP
Quantity:	Three (3)
Manufacturer:	Eagle Group / John Boos / Advance Tabco
Model:	T3084SE
Options:	E36A Welded base (3)
	YCORSI-502971-MOD Drawer (6) (2 per table)
	DOS1284-14/3 Double overshef (3)
ITEM #33	MICROWAVE OVEN
Quantity:	One (1)
Manufacturer:	Panasonic / ACP Amana
Model:	NE-1054F
ITEM #34	WORK TABLE, STAINLESS STEEL TOP
Quantity:	One (1)
Manufacturer:	Eagle Group / John Boos / Advance Tabco
Model:	T3084SE
Options:	E36A Welded base
	YCORSI-502971-MOD Drawer (2)
	DOS1284-14/3 Double overshef
	MOS1284R Microwave shelf

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ITEM #35 SPARE NUMBER

ITEM #36 SPARE NUMBER

ITEM #37 THREE COMPARTMENT SINK  
Quantity: One (1)  
Manufacturer: Eagle Group / John Boos / Advance Tabco  
Model: FN2860-3-18-14/3  
Options: 313296 Pre-rinse faucet  
313297 Add-a-faucet  
301190 Pre-rinse wall bracket  
313293 Faucet  
341189 Twist handle drain (3)  
-TB Twist bracket (3)  
326271 Sink cover (3) E47  
Sink cover holder

ITEM #38 POT SHELF  
Quantity: One (1)  
Manufacturer: Eagle Group / John Boos / Advance Tabco  
Model: WSP1260  
Options 300696 additional pothooks (5)  
Sup Info: Includes (5) pothooks.

Furnish stainless steel mounting hardware of proper type for wall construction and to sustain weight while in use.

Construction Trade shall provide wall blocking as required for mounting.

ITEM #39 BUN PAN RACK  
Quantity: Two (2)  
Manufacturer: Channel / Nexel  
Model: 404A

ITEM #40 FOOD WASTE DISPOSER  
Quantity: One (1)  
Manufacturer: Salvajor / In-sinkerator  
Model: 300-CA-ARSS-LD-PP  
Options: 18" Cone with nozzle

18CC 18" Stainless steel cone cover  
PP PP-type control panel with mounted solenoid valve, flow control & pressure switch for all controls  
980105 Mounting bracket  
DP Dejamming prong  
Sup Info: Foodservice Equipment Contractor shall furnish and install interconnecting piping and all components or parts as required by disposer manufacturer or as supplied as part of disposer in accordance with the manufacturer instructions.

Foodservice Equipment Contractor shall furnish and install all interconnecting wiring as required between disposer motor and control device.



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Mount to control panel to wall or mounting bracket with stainless steel mounting hardware of proper type for application.

Construction Trade shall reinforce wall as required to support weight of control panel while in use.

ITEM #41 L-SHAPED SOILED DISHTABLE

Quantity: One (1)

Manufacturer: Eagle Group / John Boos / Advance Tabco

Model: Custom

Construction: Top shall be fabricated of 14 gauge stainless steel. Exposed edges shall be 3" high, turned up on a 3/4" radius, terminating into a 1-1/2" diameter, 180 degree rolled edge. Provide backsplash along adjoining surfaces with top turned up integrally 10" high on a 3/4" radius at a 90 degree angle, turned back 2-1/2" on a 45 degree angle and down 1/2" on a 45 degree angle.  
Where the dishtable top enters the dishmachine, backsplash and top shall be turned down into the mouth of the dishmachine and fastened thereto in a watertight manner, as recommended by the manufacturer of the dishmachine.

Pre-rinse sink shall be fabricated of 14 gauge stainless steel with interior corners coved on a 3/4" radius and constructed integrally with dishtable top. Locate pre-rinse sink 1" from the inside roll of the dishtable front edge. Sink size shall be 20" long x 20" wide x 10" deep.

Punch top and provide T&S Brass & Bronze Works B-113 pre-rinse assembly with spray handle and B109 wall bracket.

Furnish and install Component Hardware E32-4900 stainless steel open waste outlet with flat strainer plate.

Provide 16 gauge stainless steel, perforated removable scrap basket with interior corners coved on a 3/4" radius. Scrap basket to fit inside pre-rinse sink, set 1/8" clear of sides of pre-rinse sink and provided with four 1" high stainless steel tubular fully enclosed legs. Provide scrap basket with two 1" diameter, stainless steel tubular rack guides, fully welded to sides of scrap basket and set flush with dishtable top surface.

Fabricate pass window frame and sill assembly of 14 gauge stainless steel. Coordinate length, width and wall thickness of wall opening per architectural drawings. Pass window frame shall be 2" wide on top and sides turned back 1" at 90 degrees to wall surface. Sill shall be fabricated with both edges turned down 2" at 90 degrees returned to wall 1" at 90 degrees with ends closed to sides. Fabricate frame and sill with full perimeter field joint to facilitate installation into wall opening, fully weld and polish field joint after installation into wall opening. Secure frame and sill assembly to wall opening in a concealed manner utilizing stainless steel fasteners and of a type suitable for wall construction.

Furnish and install manually operated jamb mounted counter shutter assembly in pass window opening. Shutter assembly frame, guides, bracket plates,

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hood and slats shall be fabricated of 16 gauge stainless steel; shutter assembly shall be provided less sill. Provide chrome plated cylinder type lock assembly on reinforced bottom bar. Fabricate frame with split frame assembly to facilitate installation into wall opening. Secure frame assembly to wall opening in a concealed manner per manufacturer instructions utilizing stainless steel fasteners and of a type suitable for wall construction.

Provide provisions for Item #40 food waste disposer.

Dishtable shall be reinforced with 14 gauge stainless steel, 1" x 4" x 1" "hat" channels welded to underside of dishtable top, front to rear at legs for weld anchoring leg gussets, and longitudinally the full length of the dishtable at center of top between leg channels.

Mount on leg assembly constructed of 1-5/8" diameter 16 gauge stainless steel tubing. Each leg shall be provided with a stainless steel bullet shaped adjustable foot. Fasten each leg to a 3-1/2" high stainless steel conical shaped die-formed gusset, fully welded to leg mounting channel.

Provide 1-1/4" diameter 16 gauge stainless steel tubular cross railing running between legs at a point 10" above the finished floor. Railing shall be continuously welded to legs provide a smooth coved radius.

ITEM #42            POT SHELF  
Quantity:           One (1)  
Manufacturer:      Eagle Group / John Boos / Advance Tabco  
Model:              WSP1236  
Options              300696 additional pothooks (3)  
Sup Info:           Includes (3) pothooks.

Furnish stainless steel mounting hardware of proper type for wall construction and to sustain weight while in use.

Construction Trade shall provide wall blocking as required for mounting.

ITEM #43            TRASH RECEPTACLE, 55 GAL  
Quantity:           One (1)  
Manufacturer:      Rubbermaid  
Model:              FG265500GRAY  
Options:            FG265400GRAY Lid  
                         FG264000BLA Dolly

ITEM #44            WAREWASHER  
Quantity:           One (1)  
Manufacturer:      Hobart / Champion / Jackson  
Model:              AM16T-ASR  
Options:            WTRHAMARREST-AM16 Water hammer arrestor  
                         Fan activation switch  
                         Drain tempering kit

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ITEM #45 CONDENSATE HOOD

Quantity: One (1)  
Manufacturer: Captive Aire / Accurex  
Model: Size and shape per plan  
Construction: Furnish and install condensate hood.

Entire condensate ventilation system shall be constructed in compliance with UL, NSF and any prevailing statutes and codes.

Fabricate entire hood of 18 gauge 304 stainless steel fully welded watertight construction.

Provide stainless steel welded hanger mounting clips with threaded stainless steel hanger and structural ceiling providing necessary angles and channels and utilizing stainless steel mounting hardware.

Mechanical (HVAC) Trade shall provide stainless steel welded ductwork (horizontal duct runs shall be pitched back toward condensate hood) and fan to comprise a complete condensate exhaust system.

Electrical Trade shall install fan switch with indicator lights located on dish machine and inter-wire to fan.

Furnish and install plastic drain tubing from nipple on bleeder drain outlet to soiled dishtable top surface.

Furnish and install 18 gauge stainless steel ceiling closure panels extending from the top of the exhaust ventilator to the finished ceiling. Panels shall be removable without the use of tools for access.

Furnish and install 18 gauge 304 stainless steel wall panels extending from the bottom of the rear of the exhaust hood to the upper edge of the base-board molding and extending along the full length of all wall surfaces. Wall panel sections shall be fitted with 1/2" wide off-set seams at intermediate joints to allow panel sections to fit tightly against the wall and to result in watertight seams. Secure wall panels to building wall with wall panel adhesive of proper type for wall construction. Seal end seams with General Electric or equivalent clear silicone sealer.

Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

ITEM #46 BLOWER/DRYER, WAREWASHER

Quantity: One (1)  
Manufacturer: San-Aire Industries  
Model: PD-100-M  
Options: SMB-PD-100M Standard wall mount bracket FILTERX4  
Filter Set, 6" x 20" x 3/8", washable, for PD-100M/100MCORR/100F, set of 4

ITEM #47 CLEAN DISHTABLE

Quantity: One (1)

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Manufacturer: Eagle Group / John Boos / Advance Tabco  
Model: CDTL-108-14/3

ITEM #48 POT SHELF  
Quantity: One (1)  
Manufacturer: Eagle Group / John Boos / Advance Tabco  
Model: WSP1260  
Options: 300696 additional pothooks (5)  
Sup Info: Includes (5) pothooks.

Furnish stainless steel mounting hardware of proper type for wall construction and to sustain weight while in use.

Construction Trade shall provide wall blocking as required for mounting.

ITEM #49 SNACK RACK  
Quantity: Two (2)  
Manufacturer: Metro / Eagle Group  
Model: Super Erecta Pro  
Options: PR1824NK3  
63UPK3 Posts (4)  
5MP Casters (2)  
5MPB Casters with brakes (2)  
Black matte finish (2)

Remarks: Assemble into four tier unit(s) with bottom shelf 12" above finished floor. Sup

Info: Not in Foodservice Equipment contract, furnished by the District.

ITEM #50 MILK COOLER  
Quantity: Two (2)  
Manufacturer: True / Beverage Air  
Model: TMC-34-DS-SS-HC  
Options: Swivel casters with polyurethane tires and front locking brakes (2 sets)  
Corner bumpers (2)

ITEM #51 HOT FOOD COUNTER  
Quantity: Two (2)  
Manufacturer: Duke / LTI / Delfield  
Model: TEHF-60SS  
Options: P-LAM Veneer plastic laminate on body (2)  
MOD-4P Veneer on customer's side (2)  
3BTS-HD-4CU Tray Slide, customer's side, (3) tubular Ø 1" bars, stainless steel, on hinged brackets, end caps, mounted 30"H (2)  
445-4S-HD-OP Cutting Board/Shelf, operator's side, 10"D, 18ga stainless steel shelf, (3) hinged brackets, shelf mounted flush to counter top (2) MOD-2S-4CU  
Kick plate, customer side, stainless steel (2)  
5" poly swivel casters & brakes (2) ILD  
Interlock device (2)  
Fill faucet (2)  
Owner/Architect to select laminate finish (2)

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ITEM #51.1 HOT FOOD COUNTER SNEEZE GUARD

Quantity: Two (2)  
Manufacturer: Duke / PMG /  
Versaguard Model: TS462-60  
Options: TS400LED-4 LED light  
(2) TS400HT-4 Radiant  
heater (2) 3/8" tempered  
glass (2)  
1/4" glass end panels (2)  
1" stainless steel tube posts (2)

ITEM #52 SOLID TOP COUNTER

Quantity: Two (2)  
Manufacturer: Duke / LTI /  
Delfield Model: TST-18SS  
Options: SOLID-HD-1CU Tray slide, customer side, solid stainless steel, hinged (2)  
MOD-2S-E Kick Plate, end, stainless steel, recessed, screw attached, 1/2"  
above floor for easy rolling (2)  
P-LAM Veneer plastic laminate on  
body (2) MOD-1P Veneer on customer  
side (2)  
ILD Internal locking device (2)  
5" dia. gray poly swivel casters & brakes (2)  
Owner/Architect to select laminate finish (2)

ITEM #53 COLD FOOD COUNTER

Quantity: Two (2)  
Manufacturer: Duke / LTI /  
Delfield Model: TST-60SS  
Options: ILD Internal locking device (2)  
SOLID-HD-4CU Tray Slide, customer's side, 60" W x 12-1/4" D, solid  
stain- less steel, on hinged brackets, with (2) 1/8" die-formed rubbing  
tracks, & mounted 30" high (2)  
MOD-2S-4CU Kick Plate, customer's side, stainless steel, recessed, screw  
attached, 1/2" above floor for easy rolling (2)  
P-LAM Veneer plastic laminate on  
body (2) MOD-4P Veneer on customer  
side (2)  
CUT-OP4 Rectangular cutout with reinforced turn down edges & corners  
welded closed, in counter top, body panel or a shelf, counter top max. right to  
left is 4" less than unit length (2)  
Cutting board on operator side, stainless steel, hinged (2)  
5" dia. gray poly swivel casters & brakes (2)  
District/Architect to select laminate finish (2)

ITEM #53.1 COLD FOOD COUNTER SNEEZE GUARD

Quantity: Two (2)  
Manufacturer: Duke / PMG /

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Versaguard Model: TS462-60  
Options: TS400LED-4 LED  
light (2) 3/8"  
tempered glass (2)  
1/4" glass end panels (2)  
1" stainless steel tube posts (2)

ITEM #54 FROST TOP,  
DROP IN

Quantity: Two (2)  
Manufacturer: Duke / LTI /  
Delfield Model: RFT2-SL  
Options: Drain (2)

ITEM #55 CASHIER COUNTER

Quantity: One (1)  
Manufacturer: Duke / LTI /  
Delfield Model: TCS-30SS  
Options: CS-DR-LK Stainless steel drawer, with lock and keys  
SOLID-HD-32CL Tray Slide, cashier's left, 32" W x 12-1/4" D, solid  
stainless steel, on hinged brackets, with (2) 1/8" die-formed rubbing tracks, &  
mounted 34" high  
MOD-2S-2CL Kick Plate, cashier's  
left MOD-2S-2CR Kick Plate,  
cashier's right MOD-2S-2OC Kick  
Plate, opposite cashier P-LAM Veneer  
plastic laminate on body MOD-2P-CL  
Veneer on cashier's left  
MOD-2P-OC Veneer opposite  
cashier 5" dia. gray poly swivel  
casters & brakes Owner/Architect to  
select laminate finish

ITEM #56 P.O.S. STATION

Quantity: One (1)  
Sup Info: Not in Foodservice Equipment contract, furnished by the District.

ITEM #57 NOVELTY ICE CREAM

Quantity: One (1)  
Sup Info: Not in Foodservice Equipment contract, furnished by the District.

ITEM #58 WORK TABLE, STAINLESS STEEL TOP

Quantity: One (1)  
Manufacturer: Eagle Group / John Boos / Advance  
Tabco Model: T3630SE-BS  
Options: E36A Welded base  
E59 Undershelf upgrade

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ITEM #59	DUNNAGE RACK
Quantity:	One (1)
Manufacturer:	Cambro / Metro / Eagle
Group Model:	DRS480480
Options:	DRLNK110 Camlink

END OF SECTION 114000

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## SECTION 115800 - ART EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes:
  - 1. Ceramic kilns and accessories.

#### 1.2 SUBMITTALS

- A. Product Data: Include manufacturer's specifications, assembly and installation instructions, and maintenance recommendations.
- B. Maintenance Data: For ceramic kilns, gantry tools, and accessories to include in maintenance manuals.

#### 1.3 COORDINATION

- A. Coordinate location and installation of ceramic kilns, gantry tools, and accessories with walls, base, power provisions and other construction.

### PART 2 - PRODUCTS

#### 2.1 CERAMIC KILNS

- A. Basis-of-Design Product: Provide Model No. KM-1027; SKUTT Ceramic Products, or an approved comparable product.
- B. Provide UL listed unit with firing capability and other characteristics and features as follows:
  - 1. Temperature Rating: 2350 deg F, Cone 10.
  - 2. Firing Capacity: 9.9 cubic feet.
  - 3. Firing Chamber Dimensions: Not less than 27 inches deep with 23-inch opening width.
  - 4. Power Rating: 240V, 1 phase.
    - a. Amperage Rating: 48.0 amps.
    - b. Watts Rating: 11520 W.

#### 2.2 ACCESSORIES

- A. Kiln Ventilation System: Provide for each ceramic kiln, to vent harmful fumes away from kiln to outside.



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1. Include bypass/collection box for mounting to kiln, blower system and exhaust pipe for mounting to wall, adjustable damper, and flexible connection duct.
2. Include Envirovent 2 fan accessories per manufacturer's recommendations.
3. Include EnviroLink controller per manufacturer's recommendations.

### 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.
  1. Verify critical dimensions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 KILN INSTALLATION

- A. General: Comply with manufacturer's written installation instructions for ceramic kilns and accessories. Complete equipment field assembly, where required.
- B. Install ceramic kilns, gantry tools and accessories after finishing operations, including painting, have been completed.
- C. Install units rigid, level, plumb, square, and true; anchored securely; positioned at locations and elevations indicated; in proper relation to adjacent construction; and with proper clearances for movable components throughout entire range of operation and for access to operating components.

#### 3.3 ADJUSTING AND PROTECTION

- A. After completing equipment installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop-applied finishes according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions acceptable to manufacturer and Installer that ensure ceramic kilns are without damage or deterioration at time of Substantial Completion.

#### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's personnel in operation and maintenance of ceramic kilns and accessories. Refer to Division 01 Section "Closeout Procedures."

END OF SECTION

## SECTION 116143 - STAGE CURTAINS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Stage curtains.
2. Draw-curtain tracks.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Delegated-Design Submittal: For stage-curtain systems and attachments to structure, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, and coordinated with each other, using input from installers of the items involved.
- B. Product certificates.
- C. Sample warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

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## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer of stage curtains.

## 1.7 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of stage-curtain systems 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 STAGE-CURTAIN SYSTEMS

- A. Description: Complete stage-curtain systems, including stage curtains and tracks; with necessary accessories for support and operation.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stage-curtain systems, including comprehensive engineering analysis and attachments to building structure, using performance requirements.
- B. Structural Performance: Stage-curtain systems and attachments to structure shall withstand the effects of gravity and operational loads.
- C. Fire-Test-Response Characteristics: Provide stage curtains meeting the following requirements as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Flame-Propagation Resistance: Passes NFPA 701.
    - a. Permanently attach label to each fabric of curtain assembly indicating whether fabric is inherently and permanently flame resistant or is treated with flame-retardant chemicals and whether it requires retreatment after cleaning or after a designated time period of use.
    - b. Permanently attach 12-inch- (300 mm-) square swatch of same fabric and dye lot for each fabric of a curtain assembly to the back of assembly for use as fire-resistance test strip.

## 2.3 CURTAIN FABRICS

- A. General: Provide fabrics inherently and permanently flame resistant or chemically flame resistant by immersion treatment according to performance requirements indicated. Provide fabrics of each type and color from same dye lot.
  - 1. Basis of Design product: Rose Brand, Crescent Velour, 20 oz., 100% Polyester.
  - 2. Noise Reduction Coefficient NRC: 0.95
  - 3. Color/Texture/Pattern: As selected by Architect from manufacturer's full range

## 2.4 CURTAIN FABRICATION

- A. General: Affix permanent label, stating compliance with requirements of authorities having jurisdiction, in accessible location on fabric not visible to audience. Provide vertical seams unless otherwise indicated. Arrange vertical seams so they do not fall on faces of pleats. Do not use fabric cuts less than one-half width.
- B. Vertical and Top Hems: Machine sew hems as follows unless otherwise indicated:
  - 1. Vertical Hems: Minimum 2 inches (50 mm) wide, with not less than a 1-inch (25-mm) tuck and with no selvage material visible from front of curtain. Sew open ends of hems closed.
  - 2. Turnbacks: Provide leading-edge turnbacks for traveler curtains, formed by folding back not less than 12 inches (300 mm) of face fabric, with not less than a 1-inch (25-mm) tuck, and vertically secured by sewing.
  - 3. Top Hems: Reinforced by double-stitching 3-1/2-inch- (89-mm-) wide, heavy, jute or laminated synthetic webbing to top edge on back side of curtain with not less than 2 inches (50 mm) of face fabric turned under.
- C. Fullness:
  - 1. Flat: Provide zero percent fullness in curtains.
  - 2. 50 Percent Fullness: Provide fullness, exclusive of turnbacks and hems, by sewing additional material into 3-inch (75-mm) double-stitched, flat, box pleats spaced at 12 inches (300 mm) o.c. along top hem reinforcement.
- D. Grommets: Brass, No. 3, or No. 4. For black curtains, provide brass or aluminum grommets with black finish.
- E. Bottom Hems: Machine sew hems as follows unless otherwise indicated:
  - 1. For flat curtains without fullness: 4-inch (100-mm) lined hem with pocket for sliding pipe or conduit weight and stiffener into bottom of curtain, and with a concealing flap of same fabric in front of pocket made 2 inches (50 mm) longer than bottom edge of pocket.

2. For curtains with fullness:
  - a. Curtains That Do Not Hang to Floor: Hems not less than 3 inches (75 mm) deep, and with open ends of hems sewn closed.
  - b. Floor-Length Curtains: Hems not less than 6 inches (150 mm) deep, with 1-inch (25-mm) weight tape sewn to top seam of the bottom hem, clear of the finished bottom edge, and with open ends of hems sewn closed.

## 2.5 ALUMINUM CURTAIN TRACK

- A. Aluminum Track: Extruded aluminum, ASTM B221 (ASTM B221M); alloy and temper as recommended by manufacturer for strength and corrosion resistance; black paint finish; complete with necessary accessories for support and operation.
  1. Basis of Design manufacturer: adc tracks, 1-800-360-2321, [info@automaticdevices.com](mailto:info@automaticdevices.com)
  2. Aluminum Thickness: As recommended by manufacturer for loads and operation.
- B. Curtain Rails: Provide end stops for track rails.
- C. Curtain Carriers: Standard carriers, with a quantity of carriers sufficient for track length, to suit curtain fabrication. Include one master carrier for each leading curtain edge.
- D. Clamp and Bracket Hangers: Steel clamps and brackets of sufficient strength required to support loads for attaching track to overhead support.
- E. Track-Lap Clamp: Metal to match track channel for attaching two tracks at center overlap.
- F. Manual Walk-Along Operation: Fabricate curtain track without cord, cable, pulleys, or floor pulley.
- G. Manual Cord Operation: Fabricate curtain track with cord, pulleys, and floor pulley.
  1. Operating Line: 3/8-inch- (9-mm-) diameter, stretch-resistant operating cord consisting of braided synthetic-fiber jacket over solid, synthetic-fiber, linear filaments.
  2. End Pulleys: One single dead-end and one double live-end pulley. Provide sheave(s) with shielded ball bearing(s) housed in plated-steel body finished to match track. Provide with bracket for securing off-stage curtain end.
  3. Floor Pulley: Sheave with shielded ball bearing housed in plated-steel body, painted black. Spring-tensioned type. Adjustable type.

## 2.6 STEEL CURTAIN TRACK

- A. Steel Track: Roll-formed, galvanized, commercial-quality, zinc-coated steel sheet, ASTM A653/A653M; G60 (Z180) coating designation; with continuous bottom slot and with each half of track in one continuous piece; complete with necessary accessories for support and operation.
  - 1. Basis of Design manufacturer: adc tracks, 1-800-360-2321, [info@automaticdevices.com](mailto:info@automaticdevices.com)
  - 2. Steel Thickness: As recommended by manufacturer for loads and operation.
    - a. Heavy Duty: Minimum 0.079 inch (2.01 mm).
- B. Clamp and Bracket Hangers: Steel clamps and brackets of sufficient strength required to support loads for attaching track to overhead support.
- C. Track-Lap Clamp: Metal to match track channel for attaching two tracks at center overlap.
- D. Curtain Rails: Provide end stops for track rails.
- E. Curtain Carriers: Standard carriers, with a quantity of curtain carriers sufficient for track length, to suit curtain fabrication. Include one master carrier for each leading curtain edge.
- F. Manual Cord Operation: Provide with cord operating line, 3/8-inch- (9-mm-) diameter, stretch-resistant operating cord of braided synthetic-fiber jacket over solid, synthetic-fiber, linear filaments.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Install stage-curtain system according to curtain and track manufacturer's written instructions.

### 3.2 TRACK INSTALLATION

- A. Ceiling-Mounted Track: Drill track at intervals not greater than manufacturer's written instructions for spacing, and fasten directly to structure.
- B. Install track for center-parting curtains with not less than 24-inch (600-mm) overlap of track sections at center, supported by track lap clamps.

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3.3 CURTAIN INSTALLATION

- A. Track Hung: Secure curtains to track carriers with snap hooks.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain stage curtains and tracks.

3.5 SPECIAL REQUIREMENTS

- A. Final design and details of stage curtain system to be coordinated with owner.

END OF SECTION

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## SECTION 116623 - GYMNASIUM EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Basketball equipment (Interior).
2. Safety pads.
3. Score board.
4. Volleyball equipment.
5. Climbing equipment.
6. Ball storage.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. If applicable, include assembly, disassembly, and storage instructions for removable equipment.

B. Shop Drawings: For gymnasium equipment.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include details of field assembly for removable equipment, connections, installation, mountings, floor inserts, attachments to other work, and operational clearances.
3. Include transport and storage accessories for removable equipment.

C. Coordination Drawings: Court layout plans, drawn to scale, and coordinating floor inserts, game lines, and markers applied to finish flooring. Coordinate the basketball support brackets with the structure, HVAC, lighting, sprinklers, etc.

D. Samples: For the following products:

1. Basketball Net: Full size.
2. Basketball backboard attachment.
3. Volleyball Net: Minimum 12-inch (305-mm) length by full height, including one edge and net accessories.



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4. Pad Fabric: Wall padding not less than 3 inches square, and corner and column Samples not less than 3 inches long, with specified treatments applied. Mark face of material.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Court layout plans, reflected ceiling plans, and other details, drawn to scale, and coordinated with ceiling-suspended gymnasium equipment, floor inserts, game lines, and markers applied to finished flooring, and coordinated with each other, using input from installers of the items involved:
  1. Structural members to which overhead-supported gymnasium equipment will be attached.
  2. Suspended ceiling components, if any.
  3. Items supported from building structure above the courts, including the following:
    - a. Luminaires.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Smoke detectors.
    - f. Acoustical treatments or panels.
    - g. Access panels.
- B. Setting Drawings: For embedded items and cutouts required in other work.
- C. Qualification Data: For Installer.
- D. Product Certificates: For each type of gymnasium equipment.
- E. Sample Warranty: For special warranty.

### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For gymnasium equipment to include in emergency, operation, and maintenance manuals.

### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products or an entity that employs installers and supervisors who are trained and approved by manufacturer.

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- 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.

## 1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not install gymnasium equipment until spaces are enclosed and weatherproof, wet work in spaces 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: Verify position and elevation of floor inserts and layout for gymnasium equipment.
- C. Protect all finished surfaces including walls, flooring, lighting, ducts and finishes.

## 1.7 COORDINATION

- A. Coordinate installation of floor inserts with structural floors and finish flooring installation and with court layout and game lines and markers on finish flooring.
- B. Coordinate layout and installation of overhead-supported gymnasium equipment and suspension-system components with other construction including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of gymnasium equipment that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Basketball backboard failures including glass breakage.
  - 2. Warranty Period: 5 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain each type of gymnasium equipment from single source from single manufacturer.

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- B. Products: Subject to compliance with requirements, provide products by one of the following: See drawings for specific models.

1. Porter Athletic, Inc.
2. Institutional Products, Inc.
3. Jaypro Sports Construction Group.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Basketball backstops and anchors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7."

## 2.3 BASKETBALL EQUIPMENT (INTERIOR)

- A. General: Provide equipment complying with requirements in FIBA's "FIBA Basketball Rule Book."
- B. Protruding fasteners or exposed bolt heads on front face of backboards are not permitted.
- C. Provide manufacturer's recommended connections complying with Section 055000 "Metal Fabrications" of size and type required to transfer loads to building structure.
- D. Connections: Manufacturer's standard connections or connections recommended in writing by manufacturer and complying with Section 055000 "Metal Fabrications" of size and type required to transfer loads to building structure.
- E. Overhead-Supported Backstops:
1. Folding Types:
    - a. Manufacturer's standard assembly for forward-folding, front-braced backstop, with hardware and fittings to permit folding.
    - b. Manufacturer's standard assembly for stationary, front-braced backstop.
  2. Forward Folding BOD: Porter 90949000 Forward Fold BackStop
    - a. Backboard safety padding
    - b. Saf-Strap (No. 10797100)
  3. Stationary BOD: Porter 90926000 Stationary Backstop
    - a. Backboard safety padding.
  4. Framing: Steel pipe, tubing, and shapes designed to minimize vibration during play.

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- a. Center-Mast Frame: Fully Welded with side sway bracing.
  - b. Finish: Manufacturer's standard polyester powder-coat finish.
  - c. Color: to be selected by architect from manufacturer standard color options
5. Goal Height Adjuster:
  - a. BOD: Porter Center Strut Height Adjuster Model 00901506 w/ Key Switch Operation
  - b. Adjustable from 8 to 10 feet (2.40 to 3.05 m) to top of ring with gear-drive mechanism, locking in any position within adjustment range, with visible height scale attached to side of framing.
  - c. Operation:
    - 1) Electrical: Electric operation with integral gear-drive motor, with limit switches preset to goal heights and the following:
      - a) Key Switch Operation, Wall Mounted
- F. Backstop Safety Device: Designed to limit free fall if support cable, chains, pulleys, fittings, winch, or related components fail; with mechanical automatic reset; [6000-lb (2700-kg)] load capacity; one per folding backstop.
  - a. BOD: Porter Saf-Strap (No. 10797100)
2. BOD: Porter B-797
- G. Backstop Electric Winch: Provide operating machine of size and capacity recommended in writing by manufacturer for equipment specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, and remote controls. Coordinate wiring requirements and electrical characteristics with building electrical system.
  1. BOD: Porter B-712
  2. Electrical Components, Devices, and Accessories: Listed and labeled according to NFPA 70, by a qualified testing agency, and marked for intended location and application.
  3. Operator Type: Cable drum with grooved drum and cable tension device to automatically take up cable slack and retain cable in grooves.
  4. Motor Electrical Characteristics:
    - a. Horsepower: 3/4 hp.
    - b. Voltage: 115 V ac, single phase, 60 hertz.
- H. Control Station(s):
  1. BOD: Porter – Key Switch Assembly-
  2. Intended to operate:

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- a. Height Adjustable Backboards
  - b. Raise/Lower Foldable Backboards
- 3. Refer to Electrical Dwgs for locations
- I. Goal Mounting Assembly: Compatible with goal, backboard, and support framing; with hole pattern that is manufacturer's standard for goal attachment.
  - 1. Glass Backboard Goal Mounting Assembly: Goal support framing and reinforcement designed to transmit load from goal to backboard frame and to minimize stresses on glass backboard.
  - 2. Direct Mount: Designed for mounting goal directly and independently to center mast of backboard support framing so no force, transmitted by ring, is directly applied to backboard, and rigidity and stability of goal are maximized.
- J. Basketball Backboards:
  - 1. Rectangular, Glass
    - a. BOD: Porter B-208
    - b. Provide Padding B-326
      - 1) Padding - Color to be selected by architect from manufacturer standard color selection.
- K. Basketball Goals: Complete with flanges, braces, attachment plate, and evenly spaced loops welded around underside of ring.
  - 1. BOD: Porter B-236154 POWR-Flex II Goal
  - 2. Single-Rim Basket Ring Competition Goal: Materials, dimensions, and fabrication per manufacturer's standard design.
  - 3. Type: Movable, breakaway design with manufacturer's standard breakaway mechanism and rebound characteristics identical to those of fixed, nonmovable ring.
  - 4. Mount: Front.
  - 5. Net Attachment: No-tie loops for attaching net to rim without tying.
  - 6. Finish: Powder-coat finish.
- L. Basketball Nets: 12-loop-mesh net, between 15 and 18 inches long, sized to fit rim diameter, and as follows:
  - 1. Competition Cord: Antiwhip, made from white nylon cord not less than 120-gm thread and not more than 144-gm thread.

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- M. Backboard Safety Pads: Designed for backboard thickness indicated and extending continuously along bottom and up sides of backboard and over goal mounting and backboard supports per manufacturer's standard design.
1. Attachment: Bolt on.
  2. Color: As selected by Architect from manufacturer's full range.

## 2.4 SAFETY PADS

- A. Basis of Design Product: Subject to compliance with requirements, provide product as indicated on Finish Schedule on Drawings comparable product by one of the following:
1. Safety Padding Ink, LLC
  2. Porter Athletic, Inc..
  3. Draper, Inc.
  4. Jaypro Sports Construction Group.
- B. SP-Safety series 18 Wall Pad-Padding Ink Safety Series is an indoor fixed wall padding panel. Designed for direct wall attachment. This style panel is a wood backed pad with 2" high compression polyurethane foam laminated to the face using a two part adhesion process. This combination of foam and wood is wrapped front and sides and securely stapled onto back using 18.5 oz class "A" PVC Vinyl.
1. Backer Board: 7/16" Georgia Pacific Blue Ribbon ® oriented strand board (OSB) ; Third-Party certified to the sustainable Forestry initiative ® procurement standard, Exposure 1 bond durability. Contains no added urea formaldehyde rains. Georgia-Pacific building products can contribute to LEED® certification points.
  2. Fire-Resistive Fill: 2" High Compression polyurethane foam 1.8lb density x 100 ILD
  3. Covering- 18.5 oz coated smooth matte vinyl, BAC Shield; Anti-mildew, anti-fungus, Anti-microbial, Antibacterial treated, UV treated. Passes NFPA-701, CSFM-19, and ASTM E-84 Class A fire retardant compliant.
  4. Size: Typical panel to be manufactured at 24" width x height as specified on the drawings.
  5. Number of Modular Panel Sections: As indicated on Drawings.
  6. Installation Method: Manufacturer's standard.
  7. Fabric Covering Color(s): As selected by Architect from manufacturer's standard range.
  8. All columns and corners to be pre-fabricated to fit field conditions, ensuring maximum corner protection.
  9. 1" nailing margine top and bottom along the width edge attached directly to the wall using appropriate hardware for wall type. Refer to ASTM standard for height above finished floor. 4" AFF to bottom of foam current.

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10. No Nail Margin. 1 x3 AC grade fir (or approved substitute) wrapped in matching vinyl along top and sides, mounted directly to wall top, bottom, and middle (as aligned with panel size and mounting height) using appropriate hardware for wall type. Using 15-16 gauge angled finishing nails, panels, are blind nailed into fir along top and bottom, and secured to middle fir. 4" AFF to bottom of panel.
  11. No Nail Margine aluminum z-clip mounted to wall top and bottom (as aligned with panel size and mounting height) using appropriate hardware for wall type. Opposing z-clip mounted to panels. Once hardware is securely fastened to wall and panels, panels can be nested into wall side Z-clip. 4" AFF to bottom panel
- C. Cut-out Trim: Provide manufacturer's standard flanged cut-out trim kits for fitting pads around switches, receptacles, and other obstructions.
1. Color: As selected by Architect.

## 2.5 SCOREBOARD

- A. Darktronics, BB-2142 – Single-Sided Basketball Scoreboard
1. This single-sided LED basketball scoreboard displays period time to 99:59, HOME and GUEST scores to 99, PERIOD to nine and indicates possession and bonus. Scoreboard can also score volleyball and wrestling. When period time is less than one minute, the scoreboard displays time to 1/10 of a second.
  2. Control: All Sport 5000 Wireless Indoor, DAK Score App
  3. Size: 3' x 6' 6" x 6"
  4. Color as selected by architect from standard colors
  5. Follow the manufactures instructions for power cords for two wire operation, wall mounting, etc.

## 2.6 VOLLEYBALL EQUIPMENT

- A. Source Limitations: Obtain from single source from single manufacturer
- B. Standard Rules: Provide equipment according to the requirements of FIVB's "Official Volleyball Rules"
- C. Porter, Model 00431000 Rollaway Game Standards & Accessories
1. Upright shall be 1.9 O.D. heavy wall tubing drilled with sufficient holes or volleyball and badminton. Includes holes for optional attachment reel. Each upright hsall be supplied with two eyebolts and heavy cast eye nuts for use as end of center standards. Upright shall be finished in durable, gray powder coated enamel.

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2. The base shall be 24" diameter domed steel design. Entire perimeter of base shall be encased in an endless black rubber, non-marking protection ring which allows the unit to be used indoors or outdoors. Two 3" diameter non-marking saters shall be fixed to base and allow base to be easily tipped and rolled to or from stoage area. Base shall be finished in a pit and peel resistant durable gloss finish. Base shall be equipped with a 2-3/8" OD high strength tube for attaching upright.
3. Badminton Net, 20'x30"
4. Volleyball Net, 32'X36"

## 2.7 CLIMBING EQUIPMENT

### A. Ceiling Suspended Climbing Net

1. Polypropylene ropes with 9" mesh openings, 14'W x 18'H
2. BOD: Gopher Sport, or approved equal.

### B. Ceiling Suspended Climbing Rope

1. 1-1/2" Diameter, lightweight polypro core, polyester outer layer, 24' L
2. BOD: Gopher Sport Polyplus Indoor Climbing Ropes (Beginner Knots, Turk's Head) or approved equal.

### C. Wall Mounted Monkey Bars

1. BOD: Safari Monkey Bars, Everlast Climbing, 8'L x 2'W

### D. Climbing Wall

1. BOD: Mural Climbing Wall, Everlast Climbing, 8'H x 40'L
  - a. Climber capacity: 10
  - b. # of hand holds: 200
  - c. # of unduplicated hand holds: 120
  - d. Removable safety padding per manufacturer

## 2.8 BALL STORAGE

### A. BOD: Porter 93815—BALL CART; HEAVY DUTY; 15 BALLS

1. Quantity: Minimum 6, coordinate final amount with owner prior to ordering.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for play court layout, alignment of mounting substrates, installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance of the Work.
  - 1. Verify critical dimensions.
  - 2. Examine supporting structure, subgrades, subfloors, and footings below finished floor.
  - 3. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements are clearly marked. Locate reinforcements and mark locations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's written installation instructions and competition rules indicated for each type of gymnasium equipment. Complete equipment field assembly where required.
- B. Unless otherwise indicated, install gymnasium equipment after other finishing operations, including painting, are completed.
- C. Permanently Placed Gymnasium Equipment and Components: Install rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated; in proper relation to adjacent construction; and aligned with court layout.
  - 1. Operating Gymnasium Equipment: Verify clearances for movable components of gymnasium equipment throughout entire range of operation and for access to operating components.
- D. Safety Pads: Mount with bottom edge at dimension indicated on Drawings above finished floor.
- E. Cut-out Trim: Limit cuts in face of padding from trim unit's corner-to-corner outside dimensions. Install with ends of cuts concealed behind trim flange.

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- F. Anchoring to In-Place Construction: Use anchors and fasteners where necessary to secure built-in and permanently placed gymnasium equipment to structural support and to properly transfer load to in-place construction.
- G. Connections: Connect electric operators to building electrical system.
- H. Removable Gymnasium Equipment and Components: Assemble in place to verify that equipment and components are complete and in proper working order. Instruct Owner's designated personnel in properly handling, assembling, adjusting, disassembling, transporting, storing, and maintaining units. Disassemble removable gymnasium equipment after assembled configuration is approved by Architect and Owner, and store units in location indicated on Drawings.

### 3.3 ADJUSTING

- A. Adjust movable components of gymnasium equipment to operate safely, smoothly, easily, and quietly, free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and moving parts.

### 3.4 CLEANING

- A. After completing gymnasium equipment installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop-applied finishes according to manufacturer's written instructions.
- B. Replace gymnasium equipment and finishes that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gymnasium equipment.

END OF SECTION

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## SECTION 116653 - GYMNASIUM DIVIDERS

### 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. Walk Draw Gymnasium Divider Curtain.

#### 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. Shop Drawings: For gymnasium dividers.
  - 1. Include plans showing alignment of curtains in relation to sport-court layout and overhead structural supports.
  - 2. Include elevations, sections, details, and attachments to other work.
  - 3. Include system clearances, stacking requirements, and limits for fitting into adjacent construction.
  - 4. Include point loads and locations for attachment of gymnasium dividers to structure.
  - 5. Include diagrams for power, signal, and control wiring.
- C. Samples: For each exposed product and for each item and color specified.
- D. Samples for Initial Selection: For each type of gymnasium divider curtain fabric.
- E. Samples for Verification: For divider curtain fabrics, not less than 12 inches (305 mm) square of mesh and of solid fabric.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans with divider-curtain layouts, 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 divider-curtain systems will be attached.
  - 2. Suspended ceiling components, if any.
  - 3. Items supported from building structure, including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Smoke detectors.
    - f. Acoustical treatments or panels.
    - g. Access panels.
- B. Qualification Data: For Installer.
- C. Product Certificates: For each type of gymnasium divider.
- D. Sample Warranty: For special warranty.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For gymnasium dividers to include in operation and maintenance manuals.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of gymnasium dividers that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Faulty operation of gymnasium dividers.
    - b. Tearing or deterioration of fabric, seams, or other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain each type of gymnasium equipment from single source from single manufacturer.
- B. Products: Subject to compliance with requirements, provide products by one of the following: See drawings for specific models.
  1. Porter Athletic, Inc.
  2. Institutional Products, Inc.
  3. Jaypro Sports Construction Group.

### 2.2 ROLL-UP DIVIDER SYSTEMS

- A. Divider-Curtain System, manually operated walk draw divider curtain, and as follows:
  1. BOD: Porter 90640000 – Walk Draw Gymnasium Divider Curtain
    - a. Fleximesh (top), 8' Flexivide (bottom).
  2. Curtain track shall be enclosed, formed channel type to protect rollers from collecting dust which could hinder the free operation of the curtain. Track shall be heavy-duty type, 16 gauge galvanized steel suspended from building structure at centers not to exceed 8'-0" centers. At curtain stacking area(s), track support spacing shall be 2'-0" on center. Support hardware shall be of heavy-duty high tensile ductile iron, clamp type castings or other heavy-duty supports as prescribed by building conditions and divider locations.
  3. Four wheel ball bearing, swivel type master carriers shall be located at each end of curtain. Intermediate carriers spaced on 12" centers shall be 1" diameter, dual nylon rollers with swivel type hook for attachment of electronically welded and plated, #4 twist line coil chain and S-hooks for attaching to grommets on top hem of curtain with bottom hem hanging approximately 3" above floor. Each end of divider shall be equipped with 3/4" snap swivel and wall mounted screw eye for securing to wall. Vinyl nylon strap with snap swivel shall also be provided to secure curtain against wall when not in use. Curtain shall be supplied with 1/2" of fullness per foot of room size to allow curtain to easily extend from wall to wall without stretching taunt.

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## 2.3 DIVIDER CURTAINS

- A. Upper Curtain, Mesh: Fleximesh, 11 x 11 x 1000 Denier Polyester.
- B. Lower Section: 8'-0" high Flexivide solid vinyl, polyester reinforced 19 oz. vinyl coated fabric.
- C. Hems: Top hem of curtain shall have 3/8" ID metal spur grommets spaced 12" on centers. All hems folded and electronically welded.
- D. Seams: Electronically welded.
- E. Overall Curtain Height: As indicated on Drawings, verified in field prior to fabrication.
- F. Bottom of Curtain: Approximately 2 inches (50 mm) above finished floor.
- G. Divider-Curtain Flame-Resistance Rating: Passes NFPA 701 Test 2.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for alignment of mounting substrates, installation tolerances, operational clearances,[ locations of connections to building electrical system,] and other conditions affecting performance of the Work.
  - 1. Verify critical dimensions.
  - 2. Examine supporting structure.
  - 3. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements are clearly marked. Locate reinforcements and mark locations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions.
- B. Install gymnasium dividers after other finishing operations, including painting, have been completed unless otherwise indicated.

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- C. Install gymnasium dividers level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated; in proper relation to adjacent construction; and aligned with sport-court layout.
  - 1. Verify clearances for movable components of gymnasium dividers throughout entire range of operation and for access to operating components.
- D. Electric Operators Installation: Connect electric operators to building electrical system.

### 3.3 ADJUSTING

- A. Adjust movable components of gymnasium dividers to operate safely, smoothly, easily, and quietly, free from binding, warp, distortion, uneven tension, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range; and lubricate as recommended in writing by manufacturer.

### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gymnasium dividers.

END OF SECTION 116653

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SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manually operated multi-banding roller shades with single rollers.
2. Lockdown shades.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include styles, material descriptions, construction details, 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 Verification: For each type of roller shade.

1. Shadeband Material: Not less than 10 inches square. Mark inside face of material if applicable.
2. Lockdown shade sample.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roller shades to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

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.



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1.5 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.

1.6 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. Products:
  - 1. Vertilux, VTX Clutch System, as basis of design
  - 2. MechoShade, Mecho5.
  - 3. Ecoshade.
  - 4. Hunter Douglas Contract.
  - 5. Springs Window Fashions.
- B. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED MULTI-BANDING SHADES WITH SINGLE ROLLERS

- A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated. Provide multi-banding manual operation within rooms.
  - 1. Bead Chains: Nickel-plated metal or stainless steel.
    - a. Loop Length: Full length of roller shade.
    - b. Limit Stops: Provide upper and lower ball stops.
    - c. Chain-Retainer Type: Clip, jamb mount.
- B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of

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shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: As indicated on Drawings.
2. Direction of Shadeband Roll: Regular, from back of roller.
3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

D. Shadebands:

1. Shadeband Material: Light-filtering fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
  - a. Type: Exposed with endcaps.
  - b. Color and Finish: Architect selected.

E. Installation Accessories:

1. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
  - a. Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open.
2. Endcap Covers: To cover exposed endcaps.
3. Installation Accessories Color and Finish: Architect selected.

## 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. Fabric: See Finish Schedule on Drawings.

## 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:
  1. 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.

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- 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.

## 2.5 LOCKDOWN SHADES

- A. At all interior door lites provide 'Hideaway Helper Lockdown Shade' by School Safety Solution, or equal substitution. Mount per manufacturer's instructions to door above lite at interior side of room.
  - 1. Velcro Tab Release, weighted hem bar.
  - 2. NFPA 701 Certified.

## 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.

### 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.

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- 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

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SECTION 123600 - COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Solid-surface-material countertops and backsplashes

1.2 ACTION SUBMITTALS

- A. Product Data:
  - 1. For countertop materials.
  - 2. For each type of product.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, field joints, and cutouts for plumbing fixtures.
- C. Samples for Verification: For the following products:
  - 1. One full-size solid-surface-material countertop, with front edge and backsplash, 8 by 10 inches, of construction and in configuration specified.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For the following:
  - 1. Adhesives.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. 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.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: 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

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90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

- B. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

## 1.6 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

## PART 2 - PRODUCTS

### 2.1 SOLID-SURFACE-MATERIAL COUNTERTOPS

- A. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with IFSA 2-01.
  - 1. Manufacturers: Subject to compliance with requirements, provide products as indicated on Finish Schedule on Drawings or comparable product by one of the following:
    - a. Corian, basis of design.
    - b. Wilsonart.
    - c. Avonite Surfaces.
    - d. E. I. du Pont de Nemours and Company.
    - e. Formica Corporation.
  - 2. Type: Provide Standard Type unless Special Purpose Type is indicated.
  - 3. Colors and Patterns: See Finish Schedule on Drawings.
- B. Configuration: Provide countertops with the following front and backsplash style:
  - 1. Front: Straight, slightly eased at top.
  - 2. Backsplash: Straight, slightly eased at corner.
- C. Countertops: 3/4-inch- thick, solid surface material with front edge built up with same material.
- D. Backsplashes: 3/4-inch- thick, solid surface material.
- E. Fabrication: Fabricate tops in one piece with shop-applied edges unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

### 2.2 ACCESSORY MATERIALS

- A. Provide adhesives as recommended by finish material manufacturer for each application.

## 2.3 FABRICATION

- A. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 3/4 - inch over base cabinets.
- B. Complete fabrication, including assembly and finishing 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 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.
- C. 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.

## 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 and back priming.

### 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.
- 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.
- D. Install countertops level to a tolerance of 1/8 inch in 8 feet.

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- E. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill 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.
  - 1. Install backsplashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
- F. Touch up finishing work specified in this Section after installation of wood countertops. 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.

### 3.3 CLEANING AND PROTECTION

- 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.
- C. Protect epoxy countertop surfaces during construction with 6-mil plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches o.c.

END OF SECTION



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## SECTION 142700 – CUSTOM ELEVATOR CABS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Ascend™ Elevator Protection System

#### 1.02 SECTION INCLUDES

- A. Elevator interior finish system with Palladium® beveled edge panels

#### 1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM)
- B. National Fire Protection Association (NFPA)
- C. Society of Automotive Engineers (SAE)

#### 1.04 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide Ascend™ Elevator Protection Systems that conform to the following requirements of regulatory agencies and the quality control InPro Corporation.

1. Fire Performance Characteristics: Provide Vinyl Clad Wall Panels conforming with the NFPA Class A fire rating. Surface burning characteristics as determined by ASTM E-84 shall be flame spread of 15 and smoke developed of 400.
2. Fire Performance Characteristics: Provide Stainless Steel Clad Wall Panels conforming with the NFPA Class A fire rating. Surface burning characteristics as determined by ASTM E-84 shall be flame spread of 0 and smoke developed of 10.
3. Chemical and Stain Resistance: Provide rigid vinyl that shows resistance to stain when tested in accordance with applicable provisions of ASTM D-543.
4. Fungal and Bacterial Resistance: Provide rigid vinyl that does not support fungal or bacterial growth as tested in accordance with ASTM G-21 and ASTM G-22.
5. Color Consistency: Provide components matched in accordance with SAE J-1545 - (Delta E) with a color difference no greater than 1.0 units using CIE Lab, CIE CMC, CIE LCh, Hunter Lab or similar color space scale systems.
6. GREENGUARD Certified: Provide GREENGUARD Certified material. Panels, trim pieces and reveals shall meet the requirements of GREENGUARD Certification Standards for Low-Emitting Products and GREENGUARD Product Emission Standard for Children & Schools.
7. System Impact Resistance: Provide a panel system that resists impact as tested in accordance with applicable provisions of ASTM F 476-84, paragraph 18.
8. Stainless Steel: Provide stainless steel components that conform to ASTM A240/A240M Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure vessels and for General Applications.

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9. Aluminum: Provide aluminum extrusions that conform to ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rod Wire, Profiles and tubes / ASTM B209 Standard Specification For Aluminum Alloy Sheet and Plate.

#### 1.05 SUBMITTALS

- A. Product Data: Manufacturer's printed product data for each type of Ascend™ Elevator Protection System specified.
- B. Detail Drawings: Mounting details with the appropriate fasteners for specific project substrates.
- C. Samples: Verification samples of Palladium® Wall Panel, 6" (152mm) square, of each type and color indicated.
- D. Manufacturer's Installation Instruction: Printed installation instructions for Ascend™ Elevator Protection Systems.

#### 1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in unopened factory packaging to the jobsite
- B. Inspect materials at delivery to assure that specified products have been received.
- C. Store in original packaging in a climate controlled location away from direct sunlight.

#### 1.07 PROJECT CONDITIONS

- A. Environmental Requirements: Products must be installed in an interior climate controlled environment.

#### 1.08 WARRANTY

- A. Standard Ascend™ Limited Lifetime Warranty against material and manufacturing defects.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURER

- A. Acceptable Manufacturer:  
Ascend™ Elevator Protection Systems, or approved equal.
- B. Provide all Elevator Protection Systems and IPC wall protection from a single source.

#### 2.01 MANUFACTURED UNITS

- A. Ascend™ Elevator Cab Interior Configurations
  - 1) Options shall include stainless steel handrails/stainless steel wall guards and ceilings/ceiling mounting style/ceiling lights/battery backup.

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1. Hercules: Provide elevator interior finish system that shall include 9 horizontal Inpro® wall panels and stainless steel handrail panels.
  - a. Inpro® Vinyl Clad Panel System shall have .375" (9.5 mm) thick particleboard panels having a .040" thick PVC front and back surface. Construct panels of rigid vinyl sheet permanently bonded to front surface and edges of particleboard. Permanently bond edges with "EPT" Edge Protection Technology.
  - b. Inpro® Ricochet Clad Panel System shall have .375" (9.5 mm) thick MDF panels having a .032-.040" thick Ricochet™ front and side surfaces. Construct panels of Ricochet™ Flexible Sheet permanently bonded to front surface and edges of MDF, back surface shall be melamine sealed. Permanently bond edges with "EPT" Edge Protection Technology
  - c. Inpro® Stainless Steel Clad Panel System shall have .375" (9.5 mm) thick particleboard panels having a 16 gauge or 18 gauge stainless steel front surface and black PVC back surface. Construct panels of stainless steel sheet permanently bonded to front surface and wrapped around the edges of particleboard. Brushed #4 Satin finish shall be 18 Gauge, alloy 430, 5WL finish shall be 18 gauge, alloy 304, Linen finish shall be 16 gauge, alloy 304, Sandtex finish shall be 16 gauge, alloy 304 and 3SQ finish shall be 16 Gauge, alloy 304.
    - 1) Elevator interior finish system shall include: Stainless steel toe kick – 4.25" (108mm), Stainless steel reveals - ¾" (19mm), stainless steel corners - 1¾" (44mm), stainless steel friezes - 4.0" (101.6mm).
      - a. Optional: Satin black powder coat for toe kicks, reveals, corners, and friezes.
    - 2) Options shall include stainless steel handrails/stainless steel wall guards,) and stainless steel handrail panel – 10" (254mm) and ceilings/ceiling mounting style/ceiling lights/battery backup.

B. Ascend™ Elevator Cab Ceiling Systems

1. Stainless Steel Pan ceiling with 1, 2, or 3 stainless steel panels and LED lamps. Battery backup is included.
  - a. LED Downlight Fixtures shall be warm white 4 watt LED output that produces 209 lumens per fixture
  - b. Specify Mounting Style: Side mount or Hanger rod

C. Ascend™ Elevator Cab Handrails/Wall Guards

1. Flat , ¼"(6.35mm) x 2"(51mm).

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Specify location: all walls.

Specify end style: returned ends.

#### D. Ascend™ Elevator Cab Mounting Clips

1. Ascend™ components shall be installed with a unique clip system that allows fasteners and seams to be hidden. Reveal strip shall cover fasteners and prevent tampering.

### 2.03 MATERIALS

- A. Stainless Steel: Stainless steel, toe kicks, reveals, and corners shall be fabricated from type 304 stainless steel. Handrail panels, friezes, and ceiling panels shall be fabricated from type 430 steel. Toe kick shall be 16-gauge stainless steel. Frieze and handrail panel shall be 18-gauge stainless steel. Stainless steel handrails shall be Type 304 stainless steel.
- B. Aluminum: Aluminum attachment clips shall be fabricated from 6063-T5 extruded aluminum with a mill finish. Ceiling panels shall be fabricated from type 5052-H32 with a clear anodized finish.

### 2.04 FINISHES

- A. Stainless steel toe kicks, reveals, corners, handrail panels, friezes, and ceiling panels shall have a number 4 satin finish. Stainless steel handrails shall have a polished or brushed finish.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine areas and conditions in which the Ascend™ Elevator Protection System will be installed.
  1. Complete all finishing operations, including painting, before beginning installation of panels.
- B. Wall surface shall be dry and free from dirt, grease and loose paint.

### 3.02 PREPARATION

- A. General: Prior to installation, clean substrate to remove dust, debris and loose particles.

### 3.03 INSTALLATION

- A. General: Locate the Ascend™ Elevator Protection System as indicated on the approved detail drawing for the appropriate substrate and in compliance with the IPC installation instructions. Install level and plumb at the height indicated on the drawings.

### 3.04 CLEANING

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A. At completion of the installation, clean surfaces in accordance with the IPC clean-up and maintenance instructions.

END OF SECTION

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SECTION 210000 – FIRE PROTECTION SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions Specification Sections, apply to this Section.
- B. The requirements of all other sections of Division 21 apply to this section.

1.2 WARRANTY FOR PROJECT

- A. The Contractor shall provide the Owner with a 1 year warranty on all materials, labor and systems from the date of Substantial Completion. The date of Substantial completion will be as set in a letter issued by the Architect – no exceptions.

1.3 DEFINITIONS

- A. For a complete list of definitions for this contract refer to the Division 1 specifications.
- B. Provide: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.
- C. Install: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.

1.4 SCOPE OF WORK

- A. Work Included: It is the intent of these specifications and the accompanying drawings that the Contractor shall, unless otherwise specified herein, furnish all labor, materials, tools, and equipment necessary, together with the necessary accessories to constitute a satisfactory and complete installation, to complete the installation of the fire protection work, as indicated on the drawings and described hereinafter. The Contractor shall properly install, equip, adjust and put in perfect condition, the respective portions of the work specified, and to so interconnect the various items or sections of the work to form a complete and properly operating whole. The work shall consist of, but shall not necessarily be limited to the following:
- B. Contract The building is contractually required to be a Fully Sprinkled Building as defined by NFPA-13 2016 for automatic sprinklers. Contractor is to study carefully review ALL Separate Disciplines (Architectural, Mechanical, Plumbing, Electrical etc).Contract Drawings to determine final head locations and amounts.
- C. The following is a Summary of Contract Requirements (NOTE: This list is not all inclusive)
  - 1. Provide all associated control equipment required unless otherwise noted.

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2. Providing all necessary permits, approvals, fees, etc.
  3. Provide instructions to the owner as outlined in these Specifications.
  4. Provide all cutting and patching as required to perform the work of this contract.
  5. Provide all necessary rigging as required to perform the work of this contract.
  6. Provide manufacturer startup for all systems specified as outlined in these Specifications.
  7. Provide removal of trash and general clean-up.
  8. Provide as-built drawings.
  9. Provide operation and maintenance manuals.
  10. Employ the services of the local Underwriters' Inspection Agency and pay for all associated fees.
  11. Completion Date: All Fire Protection work shall be completed on the date of substantial completion for the project as set in the Division 1 specifications.
- D. Design Hazard Level shall be Light Hazard and Ordinary Hazard (Storage rooms and Mechanical Rooms.). Contractor is to carefully review all other trade drawings to coordinate sprinkler piping layout. Fire Protection Contractor is to design and layout all areas based on equipment requirements and Contractor provided calculations signed and sealed by a Professional Engineer registered in the state of Pennsylvania.
- E. The work shall include all materials, equipment and systems shown on the drawings and work for other Divisions required to complete all the work ready for operation.
- F. The Contractor shall provide all labor, material, equipment and services for the complete and proper installation and operation of the electrical work as indicated, required or implied by the drawings and as specified herein.
- G. All of the contract specifications and all of the contract drawings are part of the Contract Documents of the Contractor. The Contractor shall review all drawings and specification divisions to determine the full scope of his work.
- H. It will be the responsibility of the Contractor to examine all Drawings (Architectural, Electrical Mechanical, Plumbing and Fire Protection) to determine the full extent of the work. All field measurements and verifications of conditions and materials will be the obligation of the Contractor. The submission of a Proposal by the Contractor will be considered an indication that all work, in compliance with these specifications and the drawings, has been included in the Proposal. It will also be considered an indication that a thorough review of conditions, materials, and all related specifications have been investigated by the Contractor, and the results of such investigations have been included in the Contractor's Proposal.
- L. WARRANTY AND START-UP
1. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion. It will not make any difference when equipment is ordered, delivered or installed, warranties will commence after the Architect issues a letter of "Substantial Completion."
  2. All equipment is to include factory start-up unless the Contractor receives written permission, from the owner, for Contractor start-up. Copies of the start-up report must be included with the Request for Final Payment; otherwise final payment will be withheld until the factory reports are submitted.

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- 3 All equipment furnished for this Owner shall include a two-year warranty on parts and labor.  
This warranty shall supersede all notations in all the other Division 21 specification sections.

**END OF SECTION**



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SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR 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. Sleeves.
  - 2. Stack-sleeve fittings.
  - 3. Sleeve-seal systems.
  - 4. Sleeve-seal fittings.
  - 5. Grout.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

2.2 STACK-SLEEVE FITTINGS

- A. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with setscrews.

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2.3 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 2. Pressure Plates: Carbon steel.
  - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
  - 2. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

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- D. Install sleeves for pipes passing through interior partitions.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

### 3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
  - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
  - 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
  - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

### 3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal 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 watertight seal.

### 3.4 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.

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- D. Using grout, seal the space around outside of sleeve-seal fittings.

### 3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:

- 1. Interior Partitions:

- a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

**END OF SECTION**

SECTION 210518 – ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Escutcheons.
  - 2. Floor plates.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. Escutcheons for 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.

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- c. Insulated Piping: One-piece, stamped-steel type.
  - 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 Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
  - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
  - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
  - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
  - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
  - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
  - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 1. New Piping: One-piece, floor-plate type.

### 3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

**END OF SECTION**

SECTION 210523 - 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. 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:

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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: VDBG - 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.



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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** and smaller.

## 2.2 TWO-PIECE BALL VALVES WITH INDICATORS

- A. 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**.
  3. Body Design: Two piece.
  4. Body Material: Forged brass or bronze.
  5. Port Size: Full or standard.
  6. Seats: PTFE.
  7. Stem: Bronze or stainless steel.
  8. Ball: Chrome-plated brass.
  9. Actuator: Worm gear or traveling nut.
  10. Supervisory Switch: Internal or external.
  11. End Connections for Valves **NPS 1** through **NPS 2**: Threaded ends.
  12. End Connections for Valves **NPS 2-1/2**: Grooved ends.

## 2.3 BRONZE BUTTERFLY VALVES WITH INDICATORS

- A. Description:
  1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 1112.
  2. Minimum: Pressure rating: **175 psig**.
  3. Body Material: Bronze.
  4. Seat Material: EPDM.
  5. Stem Material: Bronze or stainless steel.
  6. Disc: **Stainless steel**.
  7. Actuator: Worm gear or traveling nut.
  8. Supervisory Switch: Internal or external.
  9. Ends Connections for Valves **NPS 1** through **NPS 2**: Threaded ends.
  10. Ends Connections for Valves **NPS 2-1/2**: Grooved ends.

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2.4 IRON BUTTERFLY VALVES WITH INDICATORS

A. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
2. Minimum Pressure Rating: **175 psig.**
3. Body Material: Cast or ductile iron **with nylon, EPDM, epoxy, or polyamide coating**].
4. Seat Material: EPDM.
5. Stem: Stainless steel.
6. Disc: Ductile iron, **nickel plated and EPDM or SBR coated.**
7. Actuator: Worm gear or traveling nut.
8. Supervisory Switch: Internal or external.
9. Body Design: **Lug.**

2.5 CHECK VALVES

A. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: **175 psig.**
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

2.6 BRONZE OS&Y GATE VALVES

A. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: **175 psig.**
3. Body and Bonnet Material: Bronze or brass.
4. Wedge: One-piece bronze or brass.
5. Wedge Seat: Bronze.
6. Stem: Bronze or brass.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Threaded.

2.7 IRON OS&Y GATE VALVES

A. Description:

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1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: **175 psig**.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze.
5. Wedge Seat: Cast or ductile iron, or bronze.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: **Flanged**.

## 2.8 NRS GATE VALVES

### A. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: **175 psig**.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron[ **with elastomeric coating**].
5. Wedge Seat: Cast or ductile iron, or bronze[ **with elastomeric coating**].
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: [**Flanged**] [**Grooved**] [**Threaded**].

## 2.9 TRIM AND DRAIN VALVES

### A. Ball Valves:

1. Description:
  - a. Pressure Rating: **175 psig**.
  - b. Body Design: Two piece.
  - c. Body Material: Forged brass or bronze.
  - d. Port size: Full or standard.
  - e. Seats: PTFE.
  - f. Stem: Bronze or stainless steel.
  - g. Ball: Chrome-plated brass.
  - h. Actuator: Handlever.
  - i. End Connections for Valves **NPS 1** through **NPS 2-1/2**: Threaded ends.
  - j. End Connections for Valves **NPS 1-1/4** and **NPS 2-1/2**: Grooved ends.

### B. Angle Valves:

1. Description:
  - a. Pressure Rating: **175 psig**.
  - b. Body Material: Brass or bronze.
  - c. Ends: Threaded.

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- d. Stem: Bronze.
- e. Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron, bronze, or aluminum.

C. Globe Valves:

1. Description:

- a. Pressure Rating: **175 psig**.
- b. Body Material: Bronze with integral seat and screw-in bonnet.
- c. Ends: Threaded.
- d. Stem: Bronze.
- e. Disc Holder and Nut: Bronze.
- f. Disc Seat: Nitrile.
- g. Packing: Asbestos free.
- h. 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 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

- A. Comply with requirements in the following Sections for specific valve installation requirements and applications:
  - 1. Section 211100 "Facility Fire-Suppression Water-Service Piping" for application of valves in fire-suppression water-service piping outside the building.
  - 2. Section 211200 "Fire-Suppression Standpipes" for application of valves in fire-suppression standpipes.
  - 3. Section 211313 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.

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- 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.

**END OF SECTION**

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SECTION 210553 – 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 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- 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 and the proposed content for each label.
- D. Valve Schedules: Valve numbering scheme.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
  - 1. Material and Thickness: Brass, 0.032 inch thick, with predrilled holes for attachment hardware.
  - 2. Letter Color: White.
  - 3. Background Color: Red.
  - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

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5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless-steel rivets.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Red.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, 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.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and 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, 1/16 inch thick, with predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: Yellow.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches , 1/2 inch for viewing distances up to 72 inches, 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.

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- 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 according to ASME A13.1.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. 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: Size letters according to ASME A13.1 for piping.
- E. Pipe-Label Colors:
  - 1. Background Color: Safety Red.
  - 2. Letter Color: White.

## 2.4 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: Brass, 0.032 inch thick, with predrilled holes for attachment hardware.
  - 2. Fasteners: Brass wire-link chain.
  - 3. Valve-Tag Color: Safety Red.
  - 4. Letter Color: White.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch 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.

## 2.5 WARNING TAGS

- A. Description: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
  - 1. Size: 3 by 5-1/4 inches minimum.
  - 2. Fasteners: Brass grommet and wire.



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3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety Yellow background with black lettering.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

#### 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

#### 3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

#### 3.4 PIPE LABEL INSTALLATION

- A. Piping: Painting of piping is specified in Section 099123 "Interior Painting."
- B. Pipe-Label Locations: 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. Where flow pattern is not obvious, mark each pipe at branch.
  3. Near penetrations and through walls, floors, ceilings, and inaccessible enclosures.
  4. At access doors, manholes, and similar access points that permit a view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes including pipes where flow is allowed in both directions.

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3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
  - 1. Valve-Tag Size and Shape:
    - a. Fire-Suppression Standpipe: 1-1/2 inches round.
    - b. Wet-Pipe Sprinkler System: 1-1/2 inches round.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

**END OF SECTION**

SECTION 211313 – WET PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinklers.
5. Alarm devices.
6. Pressure gages.

1.2 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 indicated. Sprinkler system is to be installed with seismic restraints and per FM Global Installation Guidelines.

1.3 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. 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.
  2. Sprinkler Occupancy Hazard Classifications:
    - a. Building Service Areas: Ordinary Hazard, Group 1.
    - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    - c. General Storage Areas: Ordinary Hazard, Group 1.
    - d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
    - e. Office and Public Areas: Light Hazard.
  3. Minimum Density for Automatic-Sprinkler Piping Design:
    - a. Light-Hazard Occupancy: 0.10 gpm over most hydraulically remote 1500-sq. ft. area.
    - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over most hydraulically remote 1500-sq. ft. area.
  4. Maximum Protection Area per Sprinkler: Per UL listing.
  5. Maximum Protection Area per Sprinkler:

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- a. Patient Areas: 400 sq. ft.
  - b. Office Spaces: 225 sq. ft.
  - c. Storage Areas: 130 sq. ft.
  - d. Mechanical Equipment Rooms: 130 sq. ft.
  - e. Electrical Equipment Rooms: 130 sq. ft.
  - f. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
- a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
  - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
- C. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For wet-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.
- D. Qualification Data: For qualified Installer and professional engineer.
- E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- F. Welding certificates.
- G. 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."
- H. Field quality-control reports.
- I. Operation and maintenance data.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications:

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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. 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.
- D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
  1. NFPA 13, "Installation of Sprinkler Systems."

## 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.

### 2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- C. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- D. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- E. 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. Tyco Fire & Building Products LP.
    - e. Victaulic Company.
  2. Pressure Rating: 175 psig minimum.

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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.
- F. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Victaulic Company.
- 2.3 DUCTILE-IRON PIPE AND FITTINGS (Below grade facility supply to tunnel and to FDC and test header only)
- A. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.
  - B. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end.
  - C. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end.
  - D. Grooved-End, Ductile-Iron Pipe Appurtenances:
    1. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
    2. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
  - E. 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.
  - F. Push-on-Joint, Ductile-Iron Fittings: AWWA C153, ductile-iron compact pattern.
    1. Gaskets: AWWA C111, rubber.
  - G. Flanges: ASME B16.1, Class 125, cast iron.
- 2.4 PIPING JOINING MATERIALS
- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick.
    1. Class 125, Cast-Iron Flat-Face Flanges: Full-face gaskets.
  - B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

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- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## 2.5 LISTED FIRE-PROTECTION VALVES

### A. General Requirements:

- 1. Valves shall be UL listed or FM approved.
- 2. Minimum Pressure Rating: 175 psig.

### B. Check Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Kennedy Valve; a division of McWane, Inc.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. Reliable Automatic Sprinkler Co., Inc.
  - g. Tyco Fire & Building Products LP.
  - h. Victaulic Company.
  - i. Viking Corporation.
  - j. Watts Water Technologies, Inc.
- 2. Standard: UL 312.
- 3. Pressure Rating: 250 psig minimum.
- 4. Type: Swing check.
- 5. Body Material: Cast iron.
- 6. End Connections: Flanged or grooved.

### C. Iron OS&Y Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
  - b. American Valve, Inc.
  - c. Crane Co.; Crane Valve Group; Crane Valves.
  - d. Hammond Valve.
  - e. Milwaukee Valve Company.
  - f. Mueller Co.; Water Products Division.
  - g. NIBCO INC.
  - h. Tyco Fire & Building Products LP.
  - i. United Brass Works, Inc.
  - j. Watts Water Technologies, Inc.
- 2. Standard: UL 262.
- 3. Pressure Rating: 250 psig minimum.
- 4. Body Material: Cast or ductile iron.
- 5. End Connections: Flanged or grooved.

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D. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
  - a. Anvil International, Inc.
  - b. Global Safety Products, Inc.
  - c. Kennedy Valve; a division of McWane, Inc.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. Tyco Fire & Building Products LP.
  - g. Victaulic Company.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 and Smaller:
  - a. Valve Type: Ball or butterfly.
  - b. Body Material: Bronze.
  - c. End Connections: Threaded.
5. Valves NPS 2-1/2 and Larger:
  - a. Valve Type: Butterfly.
  - b. Body Material: Cast or ductile iron.
  - c. End Connections: Flanged, grooved, or wafer.
6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch indicating device.

2.6 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Minimum Pressure Rating: 175 psig (1200 kPa).

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Conbraco Industries, Inc.; Apollo Valves.
  - b. Kennedy Valve; a division of McWane, Inc.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
  - e. Potter Roemer.
  - f. Tyco Fire & Building Products LP.
  - g. Victaulic Company.
  - h. Watts Water Technologies, Inc.



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2.7 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Minimum Pressure Rating: 175 psig.
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. 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 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.

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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.

2.8 FIRE-DEPARTMENT CONNECTIONS

A. Flush-Type, Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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- a. AFAC Inc.
  - b. Elkhart Brass Mfg. Company, Inc.
  - c. GMR International Equipment Corporation.
  - d. Guardian Fire Equipment, Inc.
  - e. Potter Roemer.
2. Standard: UL 405.
3. Type: Flush, for wall mounting. To be approved by the local Fire Company.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
9. Outlet: With pipe threads.
10. Body Style: Horizontal.
11. Number of Inlets: Two.
12. Outlet Location: Back.
13. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
14. Finish: Polished chrome plated.
15. Outlet Size: NPS 4 or as requested by the local Fire Company.

## 2.9 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. Tyco Fire & Building Products LP.
  - d. Victaulic Company.
2. Standard: UL 213.
3. Pressure Rating: 175 psig 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.

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- 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 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.
- 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 minimum.
  - 4. Body Material: Cast- or ductile-iron housing with sight glass.
  - 5. Size: Same as connected piping.
  - 6. Inlet and Outlet: Threaded.
- E. Adjustable Drop Nipples:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CECA, LLC.
    - b. Corcoran Piping System Co.
    - c. Merit Manufacturing; a division of Anvil International, Inc.

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2. Standard: UL 1474.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

F. Flexible, Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fivalco Inc.
  - b. FlexHead Industries, Inc.
  - c. Gateway Tubing, Inc.
2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175 psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.10 SPRINKLERS

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. 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 minimum.

C. Sprinkler Finishes:

1. Chrome plated.
2. Bronze.
3. Painted.

D. Special Coatings:

1. Wax.
2. Lead.
3. Corrosion-resistant paint.

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- 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: Plastic, finish in color chosen by the architect, one piece, flat.
2. Sidewall Mounting: Plastic, white finish, 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. Victaulic Company.
  - d. Viking Corporation.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

## 2.11 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 diameter.
6. Components: Shaft length, bearings, and sleeve to suit wall construction.
7. Inlet: NPS 3/4.
8. Outlet: NPS 1 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.

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- 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.
  - 7. Design Installation: Horizontal or vertical.
- D. 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.

## 2.12 PRESSURE GAGES

- 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 diameter.
- D. Pressure Gage Range: 0 to 250 psig minimum.
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include "AIR" or "AIR/WATER" label on dial face.

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PART 3 - EXECUTION

3.1 WATER-SUPPLY CONNECTIONS

- A. Connect sprinkler piping to building's interior water-distribution piping.

3.2 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. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. 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.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- M. Install pressure gages 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.
- N. Fill sprinkler system piping with water.

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- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- Q. 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."

### 3.3 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 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 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, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- J. Steel-Piping, Cut-Grooved Joints: Cut square-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 joints.
- K. 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.
- L. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.



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### 3.4 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.

### 3.5 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center 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. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

### 3.6 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections.
- B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

### 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 Division 26 Section "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.

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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. Coordinate with fire-alarm tests. Operate as required.
6. Coordinate with fire-pump 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.

### 3.9 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

### 3.10 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Above ground piping to be Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints. Underslab piping to be ductile iron with mechanical joints or push on joint with restrained gasketed joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
  1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
  2. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
  3. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 6, shall be one of the following:
  1. Standard-weight, black-steel pipe with cut-or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  2. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

### 3.11 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.

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3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Upright sprinklers.
5. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

**END OF SECTION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions Specification Sections, apply to this Section.

1.2 WARRANTY FOR PROJECT

- A. The Contractor shall provide the Owner with a (1) one year warranty on all materials, labor and systems from the date of Substantial Completion. The date of Substantial completion will be as set in a letter issued by the Architect.

1.3 DEFINITIONS

- A. For a complete list of definitions for this contract refer to the Division 1 specifications.
- B. Provide: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.
- C. Install: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.

1.4 SCOPE OF WORK

- A. The following description of work will use the following abbreviations:
  - 1. General Contractor – GC
  - 2. Electrical Contractor – EC
  - 3. Mechanical Contractor (HVAC) – MC
  - 4. Plumbing Contractor – PC
- B. Work Included: It is the intent of these specifications and the accompanying drawings that the Contractor shall, unless otherwise specified herein, furnish all labor, materials, tools, and equipment necessary, together with the necessary accessories to constitute a satisfactory and complete installation, to complete the installation of the mechanical work, as indicated on the drawings and described hereinafter. The Contractor shall properly install, equip, adjust and put in perfect condition, the respective portions of the work specified, and to so interconnect the various items or sections of the work to form a complete and properly operating whole. The work shall consist of, but shall not necessarily be limited to the following:
  - 1. For detailed scope of work for each plumbing system, refer to the respective Division 22 specification section.
  - 2. Demolition and removal of fixtures and equipment as outlined in contract drawings.
  - 3. Demolition and removal of all domestic hot and cold water and sanitary and vent piping as indicated on contract drawings.

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4. Provide all plumbing fixtures, clean outs, access panels, sanitary waste and vent piping, domestic hot, cold and recirculation piping, hangers, supports, and controls as needed. Reconnect domestic hot and cold piping and sanitary and vent piping to existing piping where indicated.
  5. Coordinate with GC, MC, and EC for the installation of all domestic water, sanitary and vent piping to ensure proper elevations, clearances, installation schedules, excavations & backfill, is performed in an orderly fashion.
  6. Provide insulation of all plumbing equipment and piping.
  7. Connect new sanitary line to new vents up through roof as shown on drawings.
  8. Refer to Architectural Phasing plans and specifications for requirements related to construction phasing and work hours.
  9. Providing all necessary permits, approvals, fees, etc.
  10. Provide instructions to the owner as outlined in these Specifications.
  11. Provide all cutting and patching as required to perform the work of this contract.
  12. Provide all necessary rigging as required to perform the work of this contract.
  13. Provide manufacturer startup for all systems specified as outlined in these Specifications.
  14. Provide removal of trash and general clean-up.
  15. Provide as-built drawings.
  16. Provide operation and maintenance manuals.
  17. Completion Date: All plumbing work shall be completed on the date of substantial completion for the project as set in the Division 1 specifications.
- C. The work shall include all materials, equipment and systems shown on the drawings and work for other Divisions required to complete all the work ready for operation.
- D. The Contractor shall provide all labor, material, equipment and services for the complete and proper installation and operation of the electrical work as indicated, required or implied by the drawings and as specified herein.
- E. All of the specifications listed and all of the drawings listed are part of the Contract Documents of the Contractor. The Contractor shall review all drawings and specification divisions to determine the full scope of his work.
- F. It will be the responsibility of the Contractor to examine all Drawings (Architectural, Structural, Mechanical, Electrical, Plumbing, and Fire Protection) to determine the full extent of the work. All field measurements and verifications of conditions and materials will be the obligation of the Contractor. The submission of a Proposal by the Contractor will be considered an indication that all work, in compliance with these specifications and the drawings, has been included in the Proposal. It will also be considered an indication that a thorough review of conditions, materials, and all related specifications have been investigated by the Contractor, and the results of such investigations have been included in the Contractor's Proposal.
- G. Coordination between the Plumbing Contractor and Electrical Contractor:
1. The Electrical Contractor shall:
    - a. Receive and install the wall-mounted electrical control devices, thermal switches, etc., and provide all wiring for same.
    - b. Provide all fused or unfused disconnect switches and circuit breakers not supplied as part of the Plumbing system and as required by the National Electrical Code, or as shown on the drawings, or as specified.

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2. The Plumbing Contractor will:

- a. Furnish and set all motors for equipment provided as part of the Plumbing contract.
- b. Furnish all motor starters, contactors, pushbuttons and switches for local and remote control of Plumbing equipment that is not provided by the Electrical Contractor and turn over to the Electrical Contractor for installation. Combination starters shall be furnished for individual (not attached to the equipment) and for packaged equipment regardless if specified or not in the respective sections of the specification.
- c. Provide pre-wired control panels, including relays, switches, pilot lights, etc., all as shown and/or specified, complete with wiring to numbered terminal strips.
- d. Provide all-control wiring for all equipment, including all 120 V. controls. Only power supply connection to the equipment will be by the Electrical Contractor.

1.5 WARRANTY

- A. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion. It will not make any difference when equipment is ordered, delivered or installed, warranties will commence after the Architect issues his letter of "Substantial Completion."
- B. All equipment is to include factory start-up unless the Contractor receives written permission, from the owner, for Contractor start-up. Copies of the start-up report must be included with the Request for Final Payment, otherwise final payment will be withheld until the factory reports are submitted.
- C. All equipment furnished for this School shall include a warranty on parts and labor. The duration of this warranty shall be as noted in paragraph 1.2.A above. This warranty shall supersede all notations in all the other Division 22 specification sections where warranties are shorter than the duration as noted in paragraph 1.2.A above.

PART 2 - PRODUCTS (Not applicable).

PART 3 - EXECUTION (Not applicable).

**END OF SECTION**

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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. Concrete bases.
  - 10. Supports and anchorages.

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. The following are industry abbreviations for plastic materials:
  - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
  - 2. CPVC: Chlorinated polyvinyl chloride plastic.
  - 3. PVC: Polyvinyl chloride plastic.
- F. The following are industry abbreviations for rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.

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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.

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. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."



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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 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 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 thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

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. Available Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Dresser Industries, Inc.; DMD Div.
    - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.

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- d. JCM Industries.
- e. Smith-Blair, Inc.
- f. Viking Johnson.

- 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
- 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
- 4. Aboveground Pressure Piping: Pipe fitting.

## 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 Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

### 1. Available Manufacturers:

- a. Capitol Manufacturing Co.
- b. Central Plastics Company.
- c. Eclipse, Inc.
- d. Epco Sales, Inc.
- e. Hart Industries, International, Inc.
- f. Watts Industries, Inc.; Water Products Div.
- g. Zurn Industries, Inc.; Wilkins Div.

- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

### 1. Available Manufacturers:

- a. Capitol Manufacturing Co.
- b. Central Plastics Company.
- c. Epco Sales, Inc.
- d. Watts Industries, Inc.; Water Products Div.

- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

### 1. Available Manufacturers:

- a. Calpico, Inc.
- b. Lochinvar Corp.

- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

### 1. Available Manufacturers:

- a. Perfection Corp.

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- 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. Available 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: 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.

## 2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- D. PVC Pipe: ASTM D 1785, Schedule 40.

## 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, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

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- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

## 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, 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:

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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 Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
  - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
  - g. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
  - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
  - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw or spring clips.
  - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
  - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
  - l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floors.
  1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 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 large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
    - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, 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 above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
      - 1) Seal space outside of sleeve fittings with grout.
  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.

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- Q. 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.
- R. Verify final equipment locations for roughing-in.
- S. 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. 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.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### 3.3 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. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
  - 4. Wet Piping Systems: Install dielectric coupling and 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 indicated.

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- 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 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 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 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

### 3.6 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.

### 3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing 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.

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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.

END OF SECTION 220500



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. Iron, single-flange butterfly valves.
  - 3. Bronze swing check 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. RS: Rising stem.
- F. 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:

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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 61 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 ball and plug valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.

- 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.

### 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 8 and larger.
  2. Handwheel: For valves other than quarter-turn types.
  3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
  4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every plug valves, for each size square plug-valve head.
- E. Valves in Insulated Piping: With 2-inch 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. Grooved: With grooves according to AWWA C606.

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3. Solder Joint: With sockets according to ASME B16.18.
4. 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, 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. Milwaukee Valve Company.
  - d. NIBCO INC.
  - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-110.
  - b. SWP Rating: 150 psig.
  - c. CWP Rating: 600 psig.
  - 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.

## 2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

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; Jenkins Valves.
  - c. Legend Valve.
  - d. Milwaukee Valve Company.
  - e. Mueller Steam Specialty; a division of SPX Corporation.
  - f. NIBCO INC.
  - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-67, Type I.
  - b. CWP Rating: 200 psig.

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- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Stainless steel.

B. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Stainless-Steel Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Conbraco Industries, Inc.; Apollo Valves.
  - b. Cooper Cameron Valves; A div. of Cooper Cameron Corp.
  - c. Crane Co.; Crane Valve Group; Jenkins Valves.
  - d. Crane Co.; Crane Valve Group; Stockham Div.
  - e. Legend Valve.
  - f. Milwaukee Valve Company.
  - g. Mueller Steam Specialty; a division of SPX Corporation.
  - h. NIBCO INC.
  - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- 2. Description:
  - a. Standard: MSS SP-67, Type I.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
  - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
  - e. Seat: NBR.
  - f. Stem: One- or two-piece stainless steel.
  - g. Disc: Stainless steel.

2.4 BRONZE SWING CHECK VALVES

A. Class 150, 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; Stockham Division.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
- 2. Description:
  - a. Standard: MSS SP-80, Type 3.
  - b. CWP Rating: 300 psig.
  - c. Body Design: Horizontal flow.
  - d. Body Material: ASTM B 62, bronze.

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- e. Ends: Threaded.
- f. Disc: Bronze.

### 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, butterfly valves.
  - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.

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3. Throttling Service: Ball or butterfly valves.
  4. Pump-Discharge Check Valves:
    - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
    - b. NPS 2-1/2 and Larger for Domestic Water: 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 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: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
    3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
    4. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.
- 3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE
- A. Pipe NPS 2-1/2 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 ball and trim.
  - B. Pipe NPS 2-1/2 and NPS 3:
    1. Ball Valves: Two piece, full port, bronze with stainless-steel ball and trim.
    2. Iron Valves, NPS 2-1/2 to NPS 3: May be provided with threaded ends instead of flanged ends.
    3. Iron Swing Check Valves: Class 250, metal seats.

END OF SECTION 220523

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 hangers and supports for plumbing system piping and equipment:
  - 1. Steel pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Thermal-hanger shield inserts.
  - 4. Fastener systems.
  - 5. Equipment supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel pipe hangers and supports.
  - 2. Thermal-hanger shield inserts.
  - 3. Powder-actuated fastener systems.
  - 4. Pipe positioning systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze pipe hangers. Include Product Data for components.
  - 2. Metal framing systems. Include Product Data for components.
  - 3. Equipment supports.

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- C. Welding certificates.

#### 1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- B. Welding: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, "Structural Welding Code--Steel."
  - 2. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
  - 3. ASME Boiler and Pressure Vessel Code: Section IX.

### 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 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Available Manufacturers:
  - 1. AAA Technology & Specialties Co., Inc.
  - 2. B-Line Systems, Inc.; a division of Cooper Industries.
  - 3. ERICO/Michigan Hanger Co.
  - 4. Grinnell Corp.
  - 5. GS Metals Corp.
  - 6. National Pipe Hanger Corporation.
  - 7. PHD Manufacturing, Inc.
  - 8. PHS Industries, Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.



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2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Available Manufacturers:
  - 1. Carpenter & Paterson, Inc.
  - 2. ERICO/Michigan Hanger Co.
  - 3. PHS Industries, Inc.
  - 4. Pipe Shields, Inc.
  - 5. Value Engineered Products, Inc.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: 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.
  - 1. Available Manufacturers:
    - a. Hilti, Inc.
    - b. ITW Ramset/Red Head.
    - c. Masterset Fastening Systems, Inc.
    - d. MKT Fastening, LLC.
    - e. Powers Fasteners.
- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  - 1. Available Manufacturers:
    - a. B-Line Systems, Inc.; a division of Cooper Industries.
    - b. Empire Industries, Inc.
    - c. Hilti, Inc.
    - d. ITW Ramset/Red Head.
    - e. MKT Fastening, LLC.
    - f. Powers Fasteners.

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2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, 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, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified 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 on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. 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.
  - 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
  - 3. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 6, to allow off-center closure for hanger installation before pipe erection.
  - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 6.
  - 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 6.
  - 6. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 6, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
  - 7. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 6, from single rod if horizontal movement caused by expansion and contraction might occur.

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8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 6, 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 6, 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 6, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. 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 6.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 6, if longer ends are required for riser clamps.
- H. 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 for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. 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-joint 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. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  7. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  8. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  9. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  10. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  11. 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.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.

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12. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  13. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  14. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. 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.
- K. 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 Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
  4. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
  5. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
  6. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
- 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-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fastener or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.
- 3.2 HANGER AND SUPPORT INSTALLATION
- A. Steel 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 building structure.
- B. 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 above for individual pipe hangers.

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- 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 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 Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- G. Install hangers and supports complete with necessary 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 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 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 so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- N. Insulated Piping: Comply with the following:
  - 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 according to 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.

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- a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 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 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: 12 inches long and 0.048 inch thick.
  - b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
  - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
  - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.3 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 smooth bearing surface.
- 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 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 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.

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- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

- A. Touch Up: 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.
- B. Touch Up: 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.

END OF SECTION 220529

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. Pipe labels.
  - 3. Valve 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. Metal Labels for Equipment:



1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Blue.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, 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.

C. 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.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch 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 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.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. 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 high.

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2.3 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch 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.

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 Section "Interior Painting."
- B. 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 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:

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1. Domestic Water Piping:
  - a. Background Color: Green.
  - b. Letter Color: White.
2. Sanitary Waste Piping:
  - a. Background Color: Black.
  - b. Letter Color: White.
3. Natural Gas Piping:
  - a. Background Color: Yellow.
  - b. Letter Color: Black

#### 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: 1-1/2 inches round.
    - b. Hot Water: 1-1/2 inches round.
  2. Valve-Tag Color:
    - a. Cold Water: Natural.
    - b. Hot Water: Natural.
  3. Letter Color:
    - a. Cold Water: White.
    - b. Hot Water: 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 220553

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. Insulating cements.
- 3. Adhesives.
- 4. Sealants.
- 5. Field-applied jackets.
- 6. Tapes.
- 7. Securements.
- 8. Corner angles.

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).

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.

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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.

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. 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 (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.

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2.2 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 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. 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).
  - 3. 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).

2.3 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
  - 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. 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.
  - 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, available products that may be incorporated into the Work include, but are not limited to, 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.

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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).

## 2.4 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.

## 2.5 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.
  3. Thickness: 11.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch 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.
  3. Thickness: 6.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

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- 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 Bilrite Company; 370 White PVC tape.
  - d. Venture Tape; 1506 CW NS.
2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch 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 Bilrite Company; 488 AWF.
  - d. Venture Tape; 3520 CW.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

## 2.6 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; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch 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, 0.106-inch-diameter shank, length to suit depth of insulation indicated.



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- 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, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, 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 thick by 2 inches square.
  - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- 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. 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, available products that may be incorporated into the Work include, but are not limited to, 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 thick by 2 inches square.
  - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive-backed base with a peel-off protective cover.

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5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
  - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, 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- wide, stainless steel or Monel.
- D. Wire: 0.080-inch nickel-copper alloy.
  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. C & F Wire.
    - b. Childers Products.
    - c. PABCO Metals Corporation.
    - d. RPR Products, Inc.

### 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 thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F . Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

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- 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F 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.

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2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. 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 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 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.

### 3.4 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. 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" Firestopping and fire-resistive joint sealers.

### 3.5 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.

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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 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.
  6. 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.
  7. 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.
- 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.

### 3.6 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:

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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 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 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.

C. 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.

3.7 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.

3.8 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:

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1. 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.

### 3.9 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.
  2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.10 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
  1. NPS 1 and Smaller: Insulation shall be one of the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  2. NPS 1-1/4 and Larger: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
  1. NPS 3/4 and Smaller: Insulation shall be one of the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  2. NPS 1 and Larger: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

END OF SECTION 220700

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 water-distribution piping and related components outside the building and in the meter pits for water service piping.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

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.
- B. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements:
  - 1. Comply with requirements of utility company supplying water, Aqua Pennsylvania. Include tapping of water mains.
  - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- D. NSF Compliance:



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1. Comply with NSF 61 Annex G for materials for water-service piping and specialties for domestic water.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, 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, including fire hydrants, 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.

#### 1.8 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
  1. Notify Owner no fewer than three days in advance of proposed interruption of service.
  2. Do not proceed with interruption of water-distribution service without Owner's written permission.

#### 1.9 COORDINATION

- A. Coordinate connection to water main with utility company.

### PART 2 - PRODUCTS

#### 2.1 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.

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1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
  2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts. Pipe and fittings in first paragraph and subparagraphs below are available in NPS 3 to NPS 48 (DN 80 to DN 1200).
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
  2. Gaskets: AWWA C111, rubber.
- C. Polyethylene pipe: AWWA C901, ASTM D2239, ASTM D3035
1. Polyethylene pipe fittings: ASTM D2609, ASTM, D2683, ASTM D3261.

## 2.2 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Provide product by one of the following manufacturer or an engineer approved equal:
  - a. Kennedy Valve Co.
  - b. M & H Valve Co.
  - c. Mueller Co.
  - d. Nibco Inc.
2. Rising-Stem, 250 PSI working pressure, Resilient-Seated Gate Valves:
  - a. Description: Gray or ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut. Valves to open left and have outside screw and yoke (rising stem).
    - 1) Standard: AWWA C500.
    - 2) Minimum Pressure Rating: 250 psig.
    - 3) End Connections: Flanged.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

### 3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

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- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground water-service piping NPS 6 and smaller shall be the following:
  - 1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings and joints.

### 3.3 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

### 3.4 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground water-service piping NPS 4 and NPS 6 shall be any of the following:
  - 1. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed, mechanical-joint pipe or ductile-iron, mechanical-joint fittings; and mechanical joints.
- F. Underground Fire-Service-Main Piping NPS 4 to NPS 8 shall be any of the following:
  - 1. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed, mechanical-joint pipe or ductile-iron, mechanical-joint fittings; and mechanical joints.

### 3.5 PIPING INSTALLATION

- A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.
- B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.

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- C. Make connections with tapping machine according to the following:
  - 1. Install tapping sleeve and tapping valve according to MSS SP-60.
  - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
  - 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
  - 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- D. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
- E. Bury piping with depth to match the existing piping burial depth.
- F. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- G. 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.

### 3.6 JOINT CONSTRUCTION

- A. See Section 330500 "Common Work Results for Utilities" for basic piping joint construction.
- B. Make pipe joints according to the following:
  - 1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.

### 3.7 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. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
  - 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.

### 3.8 VALVE INSTALLATION

- A. MSS Valves: Install as component of connected piping system.

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3.9 FLUSHING HYDRANT INSTALLATION

- A. Install post-type flushing hydrants with valve below frost line and provide for drainage. Support in upright position. Include separate gate valve or curb valve and restrained joints in supply piping.

3.10 FIELD QUALITY CONTROL

- A. 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.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
  - 1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

3.11 IDENTIFICATION

- A. Install continuous underground warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping.

3.12 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
  - 1. Purge new water-distribution 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 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 to stand for 3 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.

END OF SECTION 221113

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. Specialty valves.
  - 2. Flexible connectors.
  - 3. Escutcheons.
  - 4. Sleeves and sleeve seals.

1.3 SUBMITTALS

- A. Product Data: For the following products:
  - 1. Specialty valves.
  - 2. Transition fittings.
  - 3. Dielectric fittings.
  - 4. Flexible connectors.
  - 5. Escutcheons.
  - 6. Sleeves and sleeve seals.
- B. Water Samples: Specified in "Cleaning" Article.
- C. Coordination Drawings: For piping in equipment rooms and other congested areas, 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.
- D. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

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1. Notify Owner no fewer than seven days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Owner's written permission.

1.6 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: 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. 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: ASTM B 88, Type K water tube, annealed temper.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch 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, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.4 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.



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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] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
  - a. Cascade Waterworks Manufacturing.
  - b. Dresser, Inc.; Dresser Piping Specialties.
  - c. Ford Meter Box Company, Inc. (The).
  - d. JCM Industries.
  - e. Romac Industries, Inc.
  - f. Smith-Blair, Inc; a Sensus company.
  - g. 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 Unions:

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. Capitol Manufacturing Company.
  - b. Central Plastics Company.
  - c. EPCO Sales, Inc.
  - d. Hart Industries International, Inc.
  - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - f. Zurn Plumbing Products Group; Wilkins Water Control Products.
2. Description:
  - a. Pressure Rating: 150 psig at 180 deg F.
  - b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Couplings:

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. Calpico, Inc.

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- b. Lochinvar Corporation.

2. Description:

- a. Galvanized-steel coupling.
- b. Pressure Rating: 300 psig at 225 deg F.
- c. End Connections: Female threaded.
- d. Lining: Inert and noncorrosive, thermoplastic.

D. Dielectric 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. 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 at 225 deg F.
- c. End Connections: Male threaded or grooved.
- d. Lining: Inert and noncorrosive, propylene.

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. Metraflex, Inc.
- 4. Unaflex, Inc.
- 5. Universal Metal Hose; a Hyspan company

- 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.
- 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
- 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.8 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.
- C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One Piece, Stamped Steel: Chrome-plated finish with setscrew or spring clips.

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- E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.
- F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, setscrew or spring clips.
- G. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.9 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.

2.10 SLEEVE SEALS

- 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. Advance Products & Systems, Inc.
  - 2. Calpico, Inc.
  - 3. Metraflex, Inc.
  - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
  - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 2. Pressure Plates: Carbon steel.
  - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.11 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

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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 shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- D. Install shutoff valve immediately upstream of each dielectric fitting.
- E. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- F. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- G. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- 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.

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### 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. 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."
- E. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2104. 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.
- F. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints.
- G. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 3.4 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 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 "Domestic Water Piping Specialties."
  - 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 balancing 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. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.
- E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply

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with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

### 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 and Smaller: Fitting-type coupling.
  - 2. NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

### 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 and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

### 3.7 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.
- C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

### 3.8 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint 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 and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.

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3. Multiple, Straight, Horizontal Piping Runs 100 Feet 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.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
  2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
  3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  4. NPS 2-1/2: 108 inches with 1/2-inch rod.
  5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

### 3.9 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. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
  2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  3. 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.
  4. 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 and larger.

### 3.10 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
  1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.

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2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
5. Bare Piping in Equipment Rooms: One piece, cast brass.
6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

### 3.11 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
  1. Sleeves for Piping Passing through Gypsum-Board Partitions:
    - a. Steel pipe sleeves for pipes smaller than NPS 6.
    - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
    - c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
  2. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe.
  3. Sleeves for Piping Passing through Exterior Concrete Walls:
    - a. Steel pipe sleeves for pipes smaller than NPS 6.
    - b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.



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- c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
  - d. Do not use sleeves when wall penetration systems are used.
- 4. Sleeves for Piping Passing through Interior Concrete Walls:
  - a. Steel pipe sleeves for pipes smaller than NPS 6.
  - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

### 3.12 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.13 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.

### 3.14 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:

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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 and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced 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 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.

### 3.15 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.

### 3.16 CLEANING

A. Clean and disinfect 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:

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- 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
  - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
  - c. Flush system with clean, potable water until no chlorine is 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.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.17 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. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and soldered joints.
- E. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and soldered joints.
- F. Below grade incoming domestic water service, shall be the following:
1. Ductile iron, see Facility Water Distribution Piping, specifications section 221113 for details.

### 3.18 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 piping NPS 2-1/2 and smaller. Use butterfly valves with flanged ends for piping NPS 3 and larger.
  2. Throttling Duty: Use ball or globe valves for piping NPS 2-1/2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 3 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.

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- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

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. Balancing valves.
- 2. Mixing Valves
- 3. Wall hydrants.
- 4. Drain valves.
- 5. Water hammer arrestors.

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, 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."

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PART 2 - PRODUCTS

2.1 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armstrong International, Inc.
  - b. ITT Industries; Bell & Gossett Div.
  - c. NIBCO INC.
  - d. TAC Americas.
  - e. Taco, Inc.
  - f. Watts Industries, Inc.; Water Products Div.
2. Type: Ball valve with two readout ports and memory setting indicator.
3. Body: Brass or bronze,
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. 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; Stockham Div.
  - c. Hammond Valve.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. Red-White Valve Corp.
2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.2 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Conbraco Industries, Inc.

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- b. Leonard Valve Company.
  - c. Powers; a Watts Industries Co.
  - d. Watts Industries, Inc.; Water Products Div.
  - e. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1070, thermostatically controlled water tempering valve.
  - 3. Pressure Rating: 125 psig 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: 110 deg F.
  - 9. Tempered-Water Design Flow Rate: 1.5 gpm.

## 2.3 WALL HYDRANTS

### A. Non-freeze, Wall Hydrants (P-10)

- 1. Available Manufacturers: Subject to compliance with requirements provide Zurn model Z130 Ecolotrol wall hydrant or an engineer approved equal by one of the following:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Prier Products, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Zurn Plumbing Products Group; Light Commercial Operation.
- 2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
- 3. Pressure Rating: 125 psig.
- 4. Operation: Loose key.
- 5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
- 6. Inlet: NPS 3/4.
- 7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
- 8. Box: Deep, flush mounting with cover.
- 9. Box and Cover Finish: Polished nickel bronze.
- 10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
- 11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
- 12. Operating Keys(s): Two with each wall hydrant.

## 2.4 HOSE BIBBS

### A. Interior, Wall Hydrants (P-7)

- 1. Available Manufacturers: Subject to compliance with requirements provide Jay R. Smith model 5670 exposed wall hydrant or an engineer approved equal by one of the following:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Prier Products, Inc.

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- d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Zurn Plumbing Products Group; Light Commercial Operation.
- 2. Standard: ASME A1011.
  - 3. Pressure Rating: 125 psig.
  - 4. Operation: Wheel handle.
  - 5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
  - 6. Inlet: NPS 3/4.
  - 7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
  - 8. Box: Not required.
  - 9. Box and Cover Finish: Not required.
  - 10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
  - 11. Nozzle and Wall-Plate Finish: Rough brass.

## 2.5 STRAINERS FOR DOMESTIC WATER PIPING

### A. Y-Pattern Strainers:

- 1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
- 2. Body: Bronze for NPS 2 and smaller; cast iron[ with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and] for NPS 2-1/2 and larger.
- 3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- 4. Screen: Stainless steel with round perforations, unless otherwise indicated.
- 5. Perforation Size:
  - a. Strainers NPS 2 and Smaller: 0.020 inch.
  - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
- 6. Drain: Pipe plug.

## 2.6 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 minimum CWP.
- 3. Size: NPS 3/4.
- 4. Body: Copper alloy.
- 5. Ball: Chrome-plated brass.
- 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.

### B. Gate-Valve-Type, Hose-End Drain Valves:

- 1. Standard: MSS SP-80 for gate valves.
- 2. Pressure Rating: Class 125.



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3. Size: NPS 3/4.
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

## 2.7 WATER HAMMER ARRESTERS

### A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide Mifab Z1700 Shoktrol arrestor or an engineer approved product by one of the following:
  - a. AMTROL, Inc.
  - b. PPP Inc.
  - c. Sioux Chief Manufacturing Company, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Watts Drainage Products Inc.
  - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

## 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 (RPZ Type) 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 and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- D. Install water control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages 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.

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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 control valve, water pressure-reducing valve, solenoid valve, and pump.
- H. Install water hammer arresters in water piping according to PDI-WH 201.
- I. 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. Calibrated balancing valves.
  4. Primary, thermostatic, water mixing valves.
  5. 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 reduced-pressure-principle backflow preventer 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.

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- 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 221119

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 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. Grout.
  - 7. Welding Criteria and Testing

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, crawlspace, 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 minimum unless otherwise indicated.
  - 2. Service Regulators: 100 psig minimum unless otherwise indicated.
- B. Natural-Gas System Pressures within Buildings: Pressure is 2 psi.
- C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

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.
  - 6. Mechanical sleeve seals.
  - 7. Welding certificates.
- B. Delegated-Design Submittal: For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. 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.
- D. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.
- E. Qualification Data: For qualified professional engineer.
- F. Welding certificates.
- G. Field quality-control reports.
- H. Operation and Maintenance Data: For motorized gas valves and pressure regulators 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. 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 WELDING CRITERIA AND TESTING

- A. Each welder shall pass a Welder Qualification Test using the following procedure for that portion or phase of welds that the welder will perform. Refer to Section 14 of the Instructions to Bidders, and Section 10 of the General Requirements for additional contract requirements for testing.
  - 1. Conformance: AWS B2.1 SMAW 6G Pipe Welding
  - 2. Welding Process. SMAW

3. Position. 6G Fixed Position
4. Weld Progression. Up
5. Backing. No
6. Current/Polarity. DCEP
7. Root Opening. 1/16 to 1/8 Groove Angel. 60 degrees
8. Material/Spec. A 106
9. Thickness. (pipe/tube): Groove (in) .6" Schedule 40 Black Steel.
10. Notes. Sch. 40 Pipe
11. Filler Metal Class . E6010Rt/E7018F1
12. Other Filler Metal Class. Rt 1/8, 3/32 Filler.
13. No. Of passes (3-Pass)=Root, Fill and Cap

Test welds shall be per ASME Section IX and shall meet the standards of acceptability for visual and radiographic examination and be performed in the presence of the Owner for their inspection and approval for each welder to be qualified to perform welds for this project.

Tests shall be held at Owners Maintenance Shop after Bid Award. Contractor is responsible for bring all material to the site for the test and remove the equipment from the site once the tests are complete. Contractor shall bring (2) 6" schedule 40 Black Steel Pipes (ASTM A53 TYPE E GRADE A PIPE), (2) Slip-on ASME B16.5 Flanges (150 lbs), Rods and welding equipment.

Welds shall be inspected by a AWS Certified Welding Inspector (CWI) to conform to ASME B31 Code for Pressure Piping. This test shall be pass/fail.

Number of welds per test: 2- Flanges and (1) butt pipe weld.

This contract requirement must be performed prior to the start of any welding for this project. During the process of the work there will be welds inspected and if necessary tested by an independent certified testing inspection agency for conformance with welding standards. Welders shall only perform welding for which they have been qualified. Only qualified welders shall perform welding of piping or of appurtenances thereto in connection with the Work.

Just prior to aligning pipe for welding, the beveled ends and the area immediately adjacent thereto shall be thoroughly cleaned of paint, rust, mill scale, dirt or other foreign matter. For pipe ends to be joined by manual welding, bevel damage greater than 0.050-inch in depth shall be repaired by grinding or filing. If the modified bevel or root-face exceeds the tolerance of the welding procedure, the pipe end shall be cut off and re-beveled. Contractor shall re-cut and bevel pipe ends as necessary to maintain correct alignment and spacing of the pipe. Field bevels shall be cut to bevel and shoulder similar to the mill bevel, and as appropriate for the welding process being used. Prior to alignment, the pipe and fittings to be welded shall be inspected for defects that may impair the service life of the pipe. Gouges, grooves, pits, arc strikes, notches and other surface defects having a depth greater than 1/16-inch may be removed by grinding, provided the remaining wall thickness is not reduced below a maximum of 8% reduction and is not below nominal specified wall thickness. If the defective area exceeds this depth, the defect shall be cut out as a cylinder and the entire portion of the cut out length of pipe shall be rejected. No dents regardless of depth shall be permitted on long seam or girth welds. Dents that contain a stress raiser (arc strikes, gouge, or mechanical damage of any description) shall not be permitted and shall be removed by cutting out as a cylinder. Pounding or jacking out dents is prohibited.

Welding on long straight pipe strings, once initiated, shall be continuous until at least three (3) passes are completed, i.e., stringer, hot-pass and one (1) fill pass. Regardless of pipe size, at no time shall the interpass temperature be allowed to drop below the minimum pre-heat requirement. During welding, the welding speed(s), voltage and amperage used for each pass shall not fall outside of the range shown on the welding procedure specification. These ranges shall be based upon heat input values established by the Contractor during procedure qualification. At valves or fittings and changes of wall thickness and

fabricated assemblies, machined transition pieces shall be installed or back beveling or back welding shall be completed as required by codes and specifications. Frequent weld defects of a similar nature, which occur in spite of good welder technique, shall be sufficient cause for Owner to immediately request the Contractor to review the Welding Procedures, welding equipment and the type and condition of electrodes, in order to determine the proper remedial steps to be taken.

The specific AWS classification of each filler material shall be used as specified in the Welding Procedures. Filler materials shall be stored and controlled as recommended by the filler metal manufacturer. Defective filler materials shall be rejected and prohibited from use on the project. Where joints are welded from both sides, the first pass shall be backchipped, ground or arc-gouged to sound metal before welding the second side. This requirement shall be included in approved procedures. The root pass of all butt welds in piping, accessible from one side only, shall be welded with the SMAW process. Branch or tee connections shall be made only by full penetration welds. Peening shall not be used. Hot welds shall be protected at all times from sudden cooling or water quenching. Each layer of welding shall be smooth and essentially free of slag inclusions, porosity, and harmful undercut. In addition, the final weld layer shall be essentially free of coarse ripples, non-uniform bead patterns, high crown and deep ridges to permit the performance of any required inspection. All arc strikes, starts, and stops shall be confined to the welding groove or shall be removed by grinding. Welds containing cracks shall not be locally repaired except those obviously occurring in tacks. The entire length of weld shall be removed and the groove reprepared and re-welded. Socket welds shall have a gap of approximately 1/16-inch minimum to 1/8-inch maximum between the bottom of the socket and the end of the pipe prior to welding. Misalignment (high-low) in butt joints shall not exceed 1/16-inch unless specifically permitted in the pipe class specification.

Welding Inspections:

- a. 3rd party inspection company, hired by the District, will perform daily and/or regular visual inspections of all welds, whether onsite or offsite.
  - b. All welds shall be onsite, unless otherwise approved by the District.
  - c. If there are any disagreements on the quality of the welds by the contractor, a 3rd party company will be hired by the District to perform an onsite x-ray of the weld in question. If any welds beyond (1) fail the x-ray test, the Contractor will be responsible to pay for all subsequent 3rd party x-rays of the welds, if they disagree with the 3rd party inspector's conclusions. Otherwise, the contractor shall submit a plan to fix the failed welds or completely replace the welds in the field with new welded joints acceptable to the 3rd party inspection agency.
- B. Welding repair shall be performed using procedures and qualified welders in accordance with the specifications. Repairs of weld defects shall not be made without the knowledge of the Owner. Shallow crater cracks or star cracks which are located at the stopping points of weld beads and which are the result of metal contraction during solidification are not considered injurious defects unless their length exceeds 5/32 inch. If a shallow crater crack is larger than 5/32 inch, the weld shall be cut out and rewelded. With the exception of these shallow crater cracks, weld containing cracks, regardless of size or location, shall NOT be acceptable.
- C. Repair of defects on welds (other than cracks) by grinding is permitted if the grinding does not penetrate below the contour of the adjacent metal. Defects (other than cracks) may be repaired by welding under the following conditions:

The maximum cumulative length allowed for any repairs shall be limited to 20% of the welds circumference, except when otherwise permitted.

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1.8 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact PECO for area where Project is located. Coordinate with PECO to perform the work at the gas train to occur at the same time to minimize the down time for the Owner.
- 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 Owner no fewer than two days in advance of proposed interruption of natural-gas service.
  - 2. Do not proceed with interruption of natural-gas service without Owner's written permission.
  - 3. Interruption of natural-gas service shall only be for indicated length of time indicated by the Owner and these contract documents.

1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
  - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
  - 2. Service Regulators: 100 psig minimum unless otherwise indicated.
- B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig, and is reduced to secondary pressure of 0.5 psig or less.

2.2 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, carbon steel aboveground and stainless steel underground.



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5. Mechanical Couplings:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of 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. Steel bolts, washers, and nuts.
  - e. Coupling shall be capable of joining steel pipe to steel pipe.
  - f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.

## 2.3 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.
  6. End Fittings: Zinc-coated steel.
  7. Threaded Ends: Comply with ASME B1.20.1.
  8. Maximum Length: 72 inches.
- 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 shutoff 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 and smaller; flanged ends for NPS 2-1/2 and larger.
  3. Strainer Screen: 40 mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
  4. CWP Rating: 125 psig.
- D. 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.

## 2.4 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.

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- B. 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.

## 2.5 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 and Smaller: Comply with ASME B16.33.
  - 1. CWP Rating: 125 psig.
  - 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 and smaller.
  - 6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
  - 1. CWP Rating: 125 psig.
  - 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. Bronze Plug Valves: MSS SP-78.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of 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.
  - 7. Listing: Valves NPS 1 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.
- E. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. McDonald, A. Y. Mfg. Co.

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- 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.
- 9. Listing: Valves NPS 1 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.

F. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Flowserve.
  - b. Homestead Valve; a division of Olson Technologies, Inc.
  - c. McDonald, A. Y. Mfg. Co.
  - d. Milliken Valve Company.
  - e. Mueller Co.; Gas Products Div.
  - f. R&M Energy Systems, A Unit of Robbins & Myers, Inc.
- 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.
- 9. Listing: Valves NPS 1 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.

2.6 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 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Service Pressure Regulators: Comply with ANSI Z21.80.

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1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dungs
    - b. Fisher Control Valves and Regulators; Division of Emerson Process Management.
    - c. Invensys.
  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: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
  12. Maximum Inlet Pressure: 100 psig.
- C. Line Pressure Regulators: Comply with ANSI Z21.80.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dungs
    - b. Eclipse Combustion, Inc.
    - c. Fisher Control Valves and Regulators; Division of Emerson Process Management.
    - d. Invensys.
    - e. Maxitrol Company.
  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: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
  12. Maximum Inlet Pressure: 10 psig.
- D. Appliance Pressure Regulators: Comply with ANSI Z21.18.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Canadian Meter Company Inc.

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- b. Dungs
  - c. Eaton Corporation; Controls Div.
  - d. Harper Wyman Co.
  - e. Maxitrol Company.
  - f. SCP, Inc.
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 may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 5 psig.

## 2.7 DIELECTRIC FITTINGS

### A. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Capitol Manufacturing Company.
  - b. Central Plastics Company.
  - c. Hart Industries International, Inc.
  - d. McDonald, A. Y. Mfg. Co.
  - e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
  - f. Wilkins; Zurn Plumbing Products Group.
2. Minimum Operating-Pressure Rating: 150 psig.
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 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.
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.

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C. 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.
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.

2.8 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, 28-day compressive strength.
  3. Packaging: Premixed and factory packaged.

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 the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

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### 3.3 OUTDOOR PIPING INSTALLATION

- A. Comply with the International Fuel Gas Code and PECO requirements for installation and purging of natural-gas piping.
- B. Steel Piping with Protective Coating:
  - 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
- C. Install fittings for changes in direction and branch connections.
- D. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
- E. 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.
- F. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Division 22 Section "Meters and Gages."

### 3.4 INDOOR PIPING INSTALLATION

- A. Comply with the International Fuel Gas Code and PECO requirements 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.

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- 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 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.
- 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. 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 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 gage upstream and downstream from each line regulator. Pressure gages are specified in Division 22 Section "Meters and Gages."

### 3.5 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance.
- B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.



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### 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 B2.1 SMAW 6G Pipe Welding, using qualified processes and welding operators.
- E. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

### 3.7 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hangers and supports specified in Division 22 Section "Hangers and Supports."
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
  - 1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  - 2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  - 3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  - 4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
  - 5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

### 3.8 CONNECTIONS

- A. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- B. Install piping adjacent to appliances to allow service and maintenance of appliances.
- C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

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3.9 LABELING AND IDENTIFYING

- A. Comply with requirements in Division 22 Section "Mechanical Identification" for piping and valve identification.

3.10 PAINTING

- A. 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: Gray.

- B. 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. 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 (semigloss).
    - d. Color: Gray.

- C. 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 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. Underground natural-gas piping shall be the following:

- 1. Steel pipe with wrought-steel fittings and mechanical couplings. Coat pipe and fittings with protective coating for steel piping.

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2. Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
  - B. Aboveground natural-gas piping shall be the following:
    1. Steel pipe with wrought-steel fittings and welded joints.
  - C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
- 3.13 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG
- A. Aboveground, branch piping NPS 1-1/2 and smaller shall be the following:
    1. Steel pipe with malleable-iron fittings and threaded joints.
  - B. Aboveground, distribution piping NPS 2 and larger shall be one of the following:
    1. Steel pipe with wrought-steel fittings and welded joints.
- 3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG
- A. Aboveground, branch piping NPS 1 and smaller shall be the following:
    1. Steel pipe with malleable-iron fittings and threaded joints.
  - B. Aboveground, distribution piping NPS 1-1/4 and larger shall be one of the following:
    1. Steel pipe with steel welding fittings and welded joints.
- 3.15 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE
- A. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
    1. Bronze plug valve.
  - B. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be the following:
    1. Cast-iron, non-lubricated plug valve.
  - C. Valves in branch piping for single appliance shall be the following:
    1. Bronze plug valve.

END OF SECTION 221125

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.

1.3 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.

1.4 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.

1.5 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. 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.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy class(es).
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

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.

2.5 COPPER TUBE AND FITTINGS

- A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Copper Pressure Fittings:
  - 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 2. 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.
- D. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

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2.6 PLASTIC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
  - 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
  - 2. Solvent Cement and Adhesive Primer:
    - a. 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).
    - b. 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).

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, waste and vent piping NPS 2 and larger shall be any of the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Hubless cast-iron soil pipe and fittings standard, shielded, stainless-steel heavy duty couplings; and hubless-coupling joints.
- C. Aboveground, soil, waste and vent piping NPS 1-1/2 and smaller shall be any of the following:
  - 1. Copper Type DWV tube, copper drainage fittings, and soldered joints.
- D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
  - 1. Schedule 40 PVC pipe, PVC socket fittings, and solvent-cemented joints.

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 cleanout fitting with closure plug inside the building in sanitary force-main piping.
- D. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation

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watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

- E. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- F. 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.
- G. 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.
- H. 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 and smaller; 1 percent downward in direction of flow for piping NPS 4 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.
  - 4. Condensate Drainage Piping: 1 percent downward in direction of flow.
- I. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

### 3.4 JOINT CONSTRUCTION

- A. Plastic, Non-pressure-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.

### 3.5 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 and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

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3. Multiple, Straight, Horizontal Piping Runs 100 Feet 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 minimum rods.
- E. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
  1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
  2. NPS 3: 48 inches with 1/2-inch rod.
  3. NPS 4: 48 inches with 5/8-inch rod.
- F. Install supports for vertical PVC piping every 48 inches.
- G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.6 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 and larger.

### 3.7 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.



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- 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. 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. 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.

### 3.8 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 221316

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. Cleanouts.
  - 2. Floor drains.
  - 3. Miscellaneous sanitary drainage piping specialties.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. PP: Polypropylene plastic.
- C. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

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.

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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 FLOOR DRAINS/SINKS

A. Cast-Iron Floor Drains (FD-A):

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith 2005Y-03-NB 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; Light Commercial Operation.
- 2. Standard: ASME A112.6.3.
- 3. Pattern: Floor drain.
- 4. Body Material: Cast 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: Round.
- 15. Dimensions of Top or Strainer: 5 inch diameter.
- 16. Top Loading Classification: Light Duty.
- 17. Funnel: Not required.
- 18. Inlet Fitting: Not required.
- 19. Trap Material: Cast iron.
- 20. Trap Pattern: Standard P-trap.
- 21. Trap Protection: Proset Trap Seal.

B. Cast-Iron Floor Drains (FD-B):

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith 2350-MBG or a comparable product by one of the following:
  - a. Josam Company; Josam Div.

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- 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; Light Commercial Operation.

- 2. Standard: ASME A112.6.3.
- 3. Pattern: Floor drain.
- 4. Body Material: Cast Iron.
- 5. Seepage Flange: Required.
- 6. Anchor Flange: Required.
- 7. Clamping Device: Required.
- 8. Outlet: 3" Bottom.
- 9. Backwater Valve: Not required.
- 10. Sediment Bucket: Required.
- 11. Top or Strainer Material: Cast iron.
- 12. Top Shape: Round.
- 13. Dimensions of Top or Strainer: 8.5" diameter.
- 14. Top Loading Classification: Medium Duty.
- 15. Funnel: Not required.
- 16. Inlet Fitting: Not required.
- 17. Trap Material: Cast iron.
- 18. Trap Pattern: Standard P-trap.
- 19. Trap Protection: Proset Trap Seal.

C. Cast-Iron Floor Sink (FS-A):

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Jay R. Smith 345-Y03 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; Light Commercial Operation.
- 2. Standard: ASME A112.6.3.
- 3. Pattern: Floor drain.
- 4. Body Material: Cast iron
- 5. Seepage Flange: Required.
- 6. Anchor Flange: Required.
- 7. Outlet: Bottom.
- 8. Backwater Valve: Not required.
- 9. Coating on Interior and Exposed Exterior Surfaces: Porcelain enamel
- 10. Top or Strainer Material: Porcelain enamel
- 11. Top Shape: Square
- 12. Dimensions of Top or Strainer: 15" x 15"
- 13. Top Loading Classification: Light Duty.
- 14. Funnel: Not required.
- 15. Inlet Fitting: Not required.

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2.2 CLEANOUTS

A. Exposed Metal Cleanouts:

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. 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.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
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 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. 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. Josam Company; Josam Div.
  - b. Sioux Chief Manufacturing Company, 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; Light Commercial Operation.
2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with straight threads and gasket.
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.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

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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. 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.
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: Round nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

## 2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

### A. 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.

## 2.4 FLASHING MATERIALS

### A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

### B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft.
2. Vent Pipe Flashing: 8 oz./sq. ft.

### C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

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- D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- E. Fasteners: Metal compatible with material and substrate being fastened.
- F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- G. Solder: ASTM B 32, lead-free alloy.
- H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

### 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 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. Use NPS 4 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 for piping NPS 4 and smaller and 100 feet for larger piping.
  - 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. 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 or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch 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.

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- F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- H. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
- I. Assemble open drain fittings and install with top of hub 1 inch above floor.
- J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- K. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- L. Install vent caps on each vent pipe passing through roof.
- M. Install wood-blocking reinforcement for wall-mounting-type specialties.
- N. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- O. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

### 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.
- 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 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. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
  - 2. 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, and skirt or flange extending at least 8 inches around pipe.
  - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.



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3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches 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 FIELD QUALITY CONTROL
- A. Perform tests and inspections and prepare test reports.
  - B. 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.
- 3.5 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 221319

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Grease interceptors.
2. Precast-concrete manhole risers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of interceptor.

B. Shop Drawings: For each type and size of precast-concrete interceptor indicated.

1. Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Piping connections. Include size, location, and elevation of each.
2. Interface with underground structures and utility services.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 FIELD CONDITIONS

A. Interruption of Existing Sewer Services: Do not interrupt services to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sewer services according to requirements indicated:

1. Notify Architect no fewer than seven days in advance of proposed interruption of service.
2. Do not proceed with interruption of sewer services without Architect's written permission.

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## PART 2 - PRODUCTS

### 2.1 GREASE INTERCEPTORS

#### A. Precast-Concrete Grease Interceptors: Comply with ASTM C913.

1. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
2. Structural Design Loads:
  - a. Heavy-Traffic Load: Comply with ASTM C890, A-16.
  - b. Walkway Load: Comply with ASTM C890, A-03.
3. Resilient Pipe Connectors: ASTM C923 (ASTM C923M), cast or fitted into interceptor walls, for each pipe connection.
4. Steps: Individual FRP steps, FRP ladder, or ASTM A615/A615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of interceptor to finished grade is less than 60 inches (1500 mm).
5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.
6. Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (100-mm-) minimum-width flange and 26-inch- (660-mm-) diameter cover.
  - a. Ductile Iron: ASTM A536, Grade 60-40-18, unless otherwise indicated.
  - b. Gray Iron: ASTM A48/A48M, Class 35, unless otherwise indicated.
  - c. Include indented top design with lettering cast into cover, using wording equivalent to "GREASE INTERCEPTOR SANITARY SEWER."

### 2.2 PRECAST-CONCRETE MANHOLE RISERS

#### A. Precast Concrete Manhole Risers: ASTM C478, ASTM C913, with rubber-gasket joints.

1. Structural Design Loads:
  - a. Light-Traffic Load: Comply with ASTM C890, A-8.
  - b. Medium-Traffic Load: Comply with ASTM C890, A-12.
  - c. Heavy-Traffic Load: Comply with ASTM C890, A-16.
  - d. Walkway Load: Comply with ASTM C890, A-03.
2. Length: From top of underground concrete structure to grade.
3. Riser Sections: 3-inch (75-mm) minimum thickness and [36-inch (915-mm)] <Insert dimension> diameter.
4. Top Section: Eccentric cone unless otherwise indicated. Include top of cone to match grade ring size.

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5. Gaskets: ASTM C443 (ASTM C443M), rubber.
  6. Steps: [Individual FRP steps or FRP ladder] [Individual FRP steps, FRP ladder, or ASTM A615/A615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D4101, PP] [ASTM A615/A615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D4101, PP] <Insert material>, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals.
- B. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, diameter matching manhole frame and cover, and height as required to adjust the manhole frame and cover to indicated elevation and slope.
- C. Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (100-mm-) minimum-width flange and 26-inch- (660-mm-) diameter cover.
1. Ductile Iron: ASTM A536, Grade 60-40-18, unless otherwise indicated.
  2. Gray Iron: ASTM A48/A48M, Class 35, unless otherwise indicated.
  3. Include indented top design with lettering cast into cover, using wording equivalent to the following:
    - a. Grease Interceptors in Sanitary Sewerage System: "[INTERCEPTOR] [GREASE INTERCEPTOR] [SANITARY SEWER] <Insert lettering>."
    - b. Oil Interceptors in Sanitary Sewerage System: "[INTERCEPTOR] [OIL INTERCEPTOR] [SANITARY SEWER] <Insert lettering>."

### PART 3 - EXECUTION

#### 3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

#### 3.2 INSTALLATION

- A. Install precast concrete interceptors according to ASTM C891.
- B. Set interceptors level and plumb.
- C. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.
- D. Set tops of manhole frames and covers flush with finished surface in pavements.
1. Set tops 3 inches above finish surface elsewhere unless otherwise indicated.
- E. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.

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1. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
2. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.

### 3.3 PIPING CONNECTIONS

- A. Piping installation requirements are specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Make piping connections between interceptors and piping systems.

### 3.4 PROTECTION

- A. Protect sanitary waste interceptors from damage during construction period.
- B. Repair damage to adjacent materials caused by sanitary waste interceptor installation.

END OF SECTION

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.
  - 3. Encasement for underground metal piping.

1.3 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.

1.4 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field quality-control inspection and test reports.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

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.

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2. 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 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class(es).
- B. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

## 2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
  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.

## 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 water piping NPS 4 and smaller shall be any of the following:
  1. Hubless cast-iron soil pipe and fittings, standard, shielded, heavy duty stainless-steel couplings; and hubless-coupling joints.
- C. Aboveground, storm water piping NPS 5 and larger shall be any of the following:

1. Hubless cast-iron soil pipe and fittings and standard, shielded, heavy duty stainless-steel couplings; and hubless-coupling joints.
- D. Underground storm water piping NPS 4 and smaller shall be the following:
  1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
- E. Underground storm water piping NPS 5 and larger shall be the following:
  1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

### 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 sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- F. Install wall-penetration fitting system at each service pipe penetration through foundation wall. Make installation watertight.
- G. 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.
- H. 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.
- I. 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.
- J. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:



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1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

- K. Install engineered controlled-flow storm drainage piping in locations indicated.
- L. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

### 3.4 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- 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.

### 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 gate or full-port ball valve for piping NPS 2 and smaller.
  2. Install gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sump pump discharge.

### 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 and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

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3. Multiple, Straight, Horizontal Piping Runs 100 Feet 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 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: 60 inches with 3/8-inch rod.
  2. NPS 3: 60 inches with 1/2-inch rod.
  3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
  4. NPS 6: 60 inches with 3/4-inch rod.
  5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install supports for vertical steel piping every 15 feet.
- H. 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.

### 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. 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.

### 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

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 roof drains.
  - 2. Cleanouts.
- B. Related Requirements:
  - 1. Section 076200 "Sheet Metal Flashing and Trim" for penetrations of roofs.
  - 2. Section 078413 "Penetration Firestopping" for firestopping roof penetrations.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 ROOF DRAINS

- A. Roof Drains (RD-A):
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn ZC100-C-R or a comparable product by one of the following:
    - a. Josam Company; Josam Div.
    - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - c. Watts Drainage Products Inc..
  - 2. Standard: ASME A112.21.2M.
  - 3. Pattern: Roof drain.
  - 4. Body Material: Cast iron.
  - 5. Combination Flashing Ring and Gravel Stop: Required.

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6. Outlet: Bottom.
7. Dome Material: Cast iron.
8. Extension Collars: Required.
9. Underdeck Clamp: Required.
10. Sump Receiver: Required.
11. Insulation: Insulate roof drain body.

B. Overflow Drains (OFD-A):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn ZC100-E-C-R or a comparable product by one of the following:
  - a. Josam Company; Josam Div.
  - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - c. Watts Drainage Products Inc..
2. Standard: ASME A112.21.2M.
3. Pattern: Roof drain.
4. Body Material: Cast iron.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Outlet: Bottom.
7. Dome Material: Cast iron.
8. Extension Collars: Required.
9. Extension: 3".
10. Underdeck Clamp: Required.
11. Sump Receiver: Required.
12. Insulation: Insulate roof drain body.

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Conductor Nozzles (DSN-A)

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes. Basis of design Zurn Z199, all nickel bronze body.
2. Size: Same as connected conductor.

2.3 CLEANOUTS

A. Exposed Metal Cleanouts:

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. 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.

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2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
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 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. 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. Josam Company; Josam Div.
  - b. Sioux Chief Manufacturing Company, 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; Light Commercial Operation.
2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Inside call.
8. Closure: Brass plug with straight threads and gasket.
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.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

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. 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.
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.

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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: Round nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

D. Test Tees:

1. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301.
2. Size: Same as connected drainage piping.
3. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or no-hub, cast-iron soil-pipe test tee as required to match connected piping.
4. Closure Plug: Countersunk or raised head, brass.
5. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

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.
  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.
- B. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
  1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 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 for piping NPS 4 and smaller and 100 feet for larger piping.
  4. Locate cleanouts at base of each vertical storm piping conductor.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install test tees in vertical conductors and near floor.
- F. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.
- G. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.
  1. Comply with requirements in Section 078413 "Penetration Firestopping."

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3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." 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.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.

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



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 fuel-fired water heaters:

- 1. Commercial, high-efficiency, gas water heaters.
- 2. Compression tanks.
- 3. Water heater accessories.

1.3 DEFINITIONS

- A. LP Gas: Liquefied-petroleum fuel gas.

1.4 SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Product Certificates: For each type of commercial water heater, signed by product manufacturer.
- D. Source quality-control test reports.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For water heaters to include in emergency, operation, and maintenance manuals.
- G. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters 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. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1.
- E. ASME Compliance:
  - 1. Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
  - 2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
- F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired water heaters that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including storage tank and supports.
    - b. Faulty operation of controls.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
  - 2. Warranty Period(s): From date of Substantial Completion:
    - a. Commercial, Gas Water Heaters:
      - 1) Storage Tank & Heating Elements: Five years.
      - 2) Controls and Other Components: Two years.
    - b. Compression Tanks: Two year(s).

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 a product by one of the available manufacturers.
    - a. Bradford White Corporation.
    - b. Smith, A. O. Water Products Company.
    - c. State Industries, Inc.

2.2 COMMERCIAL, GAS WATER HEATERS

- A. Commercial, High-Efficiency, Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3. Refer to plumbing Domestic Water Heater Schedule on drawing P301 for make and model of water heater.
1. Description: Manufacturer's proprietary design to provide at least 95 percent combustion efficiency at optimum operating conditions. The following features and attributes may be modified or omitted if water heater otherwise complies with requirements for performance.
  2. Storage-Tank Construction: ASME-code steel with 150-psig minimum working-pressure rating.
    - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
      - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
      - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
    - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
    - c. Lining: Glass complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
  3. Factory-Installed, Storage-Tank Appurtenances:
    - a. Anode Rod: Replaceable magnesium.
    - b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
    - c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
    - d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
    - e. Jacket: Steel with enameled finish.
    - f. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.
  4. Burner or Heat Exchanger: Comply with UL 795 or approved testing agency requirements for high-efficiency water heaters and for natural-gas fuel.

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5. Temperature Control: Adjustable thermostat.
6. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
7. Building Automation System Interface: Normally closed dry contacts for enabling and disabling water heater.

## 2.3 COMPRESSION TANKS

- A. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
1. Available Manufacturers:
    - a. AMTROL Inc.
    - b. Armstrong Pumps, Inc.
    - c. Watts Regulator Co.
  2. Construction:
    - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
    - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
    - c. Air-Charging Valve: Factory installed.
    - d. ASME Construction: Required.
  3. Capacity and Characteristics:
    - a. Working-Pressure Rating: 150 psig.
    - b. Capacity Acceptable: See hot water heater details compression tanks.

## 2.4 WATER HEATER ACCESSORIES

- A. Gas Shutoff Valves: ANSI Z21.15/CGA 9.1, manually operated. Furnish for installation in piping.
- B. Gas Pressure Regulators: ANSI Z21.18, appliance type. Include pressure rating, capacity, and pressure differential required between gas supply and water heater.
- C. Gas Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.
- D. Combination Temperature and Pressure Relief Valves: Include relieving capacity at least as great as heat input and include pressure setting less than water heater working-pressure rating. Select each relief valve with sensing element that extends into storage tank.
1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.
- E. Pressure Relief Valves: Include pressure setting less than working-pressure rating of water heater.
1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.

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- F. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.
- G. Piping Manifold Kits: Water heater manufacturer's factory-fabricated inlet and outlet piping arrangement for multiple-unit installation. Include piping and valves for field assembly that is capable of isolating each water heater and of providing balanced flow through each water heater.
- H. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

## 2.5 SOURCE QUALITY CONTROL

- A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial water heater storage tanks before shipment to minimum of one and one-half times pressure rating.
- C. Prepare test reports.

## PART 3 - EXECUTION

### 3.1 WATER HEATER INSTALLATION

- A. Install commercial water heaters on concrete bases.
  - 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
  - 2. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install gas water heaters according to NFPA 54.
- D. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.
- E. Install gas pressure regulators on gas supplies to gas water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
- F. Install automatic gas valves on gas supplies to gas water heaters, if required for operation of safety control.
- G. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

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- H. Install combination temperature and pressure relief valves in water piping for water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- I. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.
- J. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- K. Install pressure gage(s) on inlet and outlet piping of commercial, fuel-fired water heater piping. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- L. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve and thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves and to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- M. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- N. Fill water heaters with water.
- O. Charge compression tanks with air.

### 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 water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
- 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. 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. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.

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- 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace water heaters that do not pass tests and inspections 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 commercial water heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 22 34 00

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. Sink faucets.
  - 2. Lavatory faucets.
  - 3. Flush valves.
  - 4. Water closets.
  - 5. Urinals.
  - 6. Lavatories.
  - 7. Service sinks.
  - 8. Wash fountains.
- 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.

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. 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.
- D. PVC: Polyvinyl chloride plastic.
- E. 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.



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- 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. Vitreous-China Fixtures: ASME A112.19.2M.
  - 2. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- 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. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
  - 3. Faucets: ASME A112.18.1.
  - 4. Hose-Connection Vacuum Breakers: ASSE 1011.
  - 5. Hose-Coupling Threads: ASME B1.20.7.
  - 6. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
  - 7. NSF Potable-Water Materials: NSF 61.
  - 8. Pipe Threads: ASME B1.20.1.
  - 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 miscellaneous fittings:

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1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Plastic Tubular Fittings: ASTM F 409.
4. Brass Waste Fittings: ASME A112.18.2.

- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Flexible Water Connectors: ASME A112.18.6.
2. Floor Drains: ASME A112.6.3.
3. Hose-Coupling Threads: ASME B1.20.7.
4. Off-Floor Fixture Supports: ASME A112.6.1M.
5. Pipe Threads: ASME B1.20.1.

#### 1.6 WARRANTY

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
  - a. Structural failures of unit shell.
  - b. Faulty operation of controls, blowers, pumps, heaters, and timers.
  - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Period for Commercial Applications: Three year(s) from date of Substantial Completion.

#### 1.7 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 12 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. Toilet Seats: Equal to 10 percent of amount of each type installed.

#### 1.8 FIXTURE SUPPORTS

- 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. Josam Company.
2. MIFAB Manufacturing Inc.

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3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.
7. Sloan Plumbing Products.

C. Water-Closet Supports:

1. Description: Combination carrier designed for accessible or standard mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

D. Urinal Supports:

1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

E. Lavatory Supports:

1. Description: Type I, lavatory carrier with exposed arms and tie rods for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

PART 2 - PRODUCTS

2.1 FLUSHOMETERS

A. Flushometers, (P-1):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Sloan Royal 111 SFSM-1.6 or a comparable product by one of the following:
  - a. Zurn Plumbing Products Group; Commercial Brass Operation.
  - b. Gerber Plumbing Fixtures LLC.
2. Description: Exposed automatic, flushometer for water-closet-type fixture. Include brass body with corrosion-resistant internal components, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
  - a. Internal Design: Diaphragm operation.
  - b. Style: Exposed.
  - c. Inlet Size: NPS 1.
  - d. Automatic
  - e. Consumption: 1.60 gal./flush.
  - f. Tailpiece Size: NPS 1-1/2 standard length to top of bowl.

B. Flushometers, (P-3):

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1. Basis-of-Design Product: Subject to compliance with requirements, provide Sloan Royal 186-1.0 or a comparable product by one of the following:
  - a. Zurn Plumbing Products Group; Commercial Brass Division.
  - b. Gerber Plumbing Fixtures LLC.
2. Description: Automatic operated, flushometer for urinal-type fixture. Include brass body with corrosion-resistant internal components, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
  - a. Internal Design: Diaphragm operation.
  - b. Style: Exposed.
  - c. Inlet Size: NPS 3/4.
  - d. Trip Mechanism: Automatic
  - e. Consumption: 1.0 gal./flush.

## 2.2 LAVATORY FAUCETS

### A. Lavatory Faucets, (P-2):

1. Basis-of-Design Product: Subject to compliance with requirements, provide T&S Brass model EC-3103-VF05 faucet or a comparable product by one of the following:
  - a. American Standard Companies, Inc.
  - b. Chicago Faucets..
  - c. Zurn Plumbing Products Group; Commercial Brass Operation.
2. Description: Automatic operated lavatory faucet complete with thermostatic mixing valve.
  - a. Body Material: Commercial, solid brass.
  - b. Finish: Polished chrome plate.
  - c. Maximum Flow Rate: 1.5 gpm.
  - d. Centers: 4 inches.
  - e. Mounting: Deck, exposed.
  - f. Valve Handle(s): Not applicable.
  - g. Inlet(s): NPS 3/8.
  - h. Spout: Rigid type.
  - i. Spout Outlet: Aerator.
  - j. Operation: Automatic.
  - k. Drain: Grid.
  - l. Tempering Device: 1/2" Watts MMV-US-M1 mixing valve or other ASSE 1070 approved valve.

## 2.3 SINK FAUCETS

### A. Sink Faucets, (P-5)

1. Basis-of-Design Product: Subject to compliance with requirements, provide Advance Tabco K-59 or a comparable product by one of the following:

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- a. Elkay, Inc.
  - b. Chicago Faucets.
  - c. American Standard, Inc.
  - d. Zurn Plumbing Products Group; Commercial Brass Operation.
2. Description: Faucet without spray. 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 gpm, aerator with faucet.
  - d. Mixing Valve: Two-lever handle.
  - e. Backflow Protection Device for Hose Outlet: Not required.
  - f. Centers: 4 inches.
  - g. Mounting: Deck, exposed.
  - h. Handle(s): Wrist blade, 4 inches.
  - i. Inlet(s): NPS 3/8 plain-end tubing.
  - j. Spout Type: Swivel, solid brass.
  - k. Spout Outlet: Aerator.
  - l. Vacuum Breaker: Not required.
  - m. Operation: Compression, manual.
  - n. Drain: Grid.
  - o. Mixing Valve: ASSE 1070 compliant mixing valve on hot water supply.

B. Sink Faucets, (P-6)

1. Basis-of-Design Product: Subject to compliance with requirements, provide Chicago Faucets 895-317GN8AE35ABCP or a comparable product by one of the following:
  - a. Elkay, Inc.
  - b. American Standard, Inc.
  - c. Zurn Plumbing Products Group; Commercial Brass Operation.
2. Description: Faucet without spray. 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: 1.5 gpm, aerator with faucet.
  - d. Mixing Valve: Single-lever handle.
  - e. Backflow Protection Device for Hose Outlet: Not required.
  - f. Centers: 4 inches.
  - g. Mounting: Deck, exposed.
  - h. Handle(s): Lever.
  - i. Inlet(s): NPS 1/2 plain-end tubing.
  - j. Spout Type: Swivel, solid brass.
  - k. Spout Outlet: Aerator.
  - l. Vacuum Breaker: Not required.
  - m. Operation: Compression, manual.

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2.4 TOILET SEATS

A. Toilet Seats, (P-1,P-1A, P-1B):

- a. Basis-of-Design Product: Subject to compliance with requirements, provide; Church 295SSCT 047 or approved equal.
  - b. American Standard
  - c. Kohler Co.
  - d. Olsonite Corp.
2. Description: Toilet seat for water-closet-type fixture.
- a. Material: Molded, solid plastic.
  - b. Configuration: Open front without cover.
  - c. Size: Elongated.
  - d. Hinge Type: SS, self-sustaining.
  - e. Class: Standard commercial.
  - f. Color: White.

2.5 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers, (PSG-A):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. McGuire Manufacturing Co., Inc.
  - b. Plumberex Specialty Products Inc.
  - c. TCI Products.
  - d. TRUEBRO, Inc.
  - e. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
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.

2.6 WATER CLOSETS

A. Water Closets, (P-1,P-1A):

1. Basis-of-Design Product: Subject to compliance with requirements, provide American Standard Afall 3351.101 or a comparable product by one of the following:
  - a. Zurn, Inc.
  - b. Kohler Co.
  - c. TOTO USA, Inc.
2. Description Wall hung, back-outlet, vitreous-china fixture designed for flushometer valve operation.

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- a. Style: Flushometer valve.
  - 1) Bowl Type: Elongated with siphon-jet design.
  - 2) Design Consumption: 1.60 gal./flush.
  - 3) Color: White.
- b. Flushometer: Auto
- c. Toilet Seat: Open front
- d. Fixture Support: Fixture to be hung using existing support.
- e. Refer to architectural plans for water closet mounting heights. Water closet will be mounted at standard and ADA height.

B. Water Closets, (P-1B): Floor mounted, floor outlet, close coupled (gravity tank), vitreous china.

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide American Standard Champion Pro Right Height elongated toilet 211AA.104 or a comparable product by one of the following:
  - a. Zurn, Inc.
  - b. Kohler Co.
  - c. TOTO USA, Inc.
- 2. Bowl:
  - a. Standards: ASME A112.19.2/CSA B45.1, ASME A112.19.5, and ASSE 1037.
  - b. Bowl Type: Siphon jet.
  - c. Height: ADA.
  - d. Rim Contour: Elongated.
  - e. Water Consumption: Water saving.
  - f. Color: White.
- 3. Supply Fittings:
  - a. Standard: ASME A112.18.1/CSA B125.1.
  - b. Supply Piping: Chrome-plated-brass pipe or chrome-plated-copper tube matching water-supply piping size. Include chrome-plated wall flange.
  - c. Stop: Chrome-plated-brass, one-quarter-turn, ball-type or compression stop with inlet connection matching water-supply piping type and size.
    - 1) Operation: Loose key.
  - d. Riser:
    - 1) Size: NPS 1/2.
    - 2) Material: ASME A112.18.6, braided- or corrugated-stainless-steel flexible hose.

2.7 URINALS

A. Urinals, (P-3, P-3A):

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1. Manufacture Basis-of-Design Product: Subject to compliance with requirements, provide American Standard Washbrook Flowise Model 6590.001 urinal or a comparable product by one of the following:
  - a. American Standard Companies, Inc.
  - b. Mansfield
  - c. Zurn, Inc.
2. Description: Wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.
  - a. Type: Standard Efficiency, 1.0 GPF.
  - b. Color: White.
  - c. Top Spud: 3/4".
  - d. Outlet Size: NPS 2.
  - e. Flushometer: Auto
  - f. Fixture Support: Provide new urinal support.

2.8 COMMERCIAL SINKS

A. Triple Bowl Sink, (P-6):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Advance Tabco SS DI-3-1410 or a comparable product by one of the following:
  - a. Advance Tabco.
  - b. Just Manufacturing Company.
  - c. Metal Masters Foodservice Equipment Co., Inc.
2. Description: Triple bowl, counter-mounting, stainless-steel commercial sink.
  - a. Overall Dimensions: 50 by 21 inches.
  - b. Metal Thickness: 18 gauge.
  - c. Compartment:
    - 1) Dimensions: 18 x 14 inches.
    - 2) Depth: 10 inches.
    - 3) Drain: 2"
      - a) Location: Center of compartment.
  - d. Faucet(s): Sink SF-A.
    - 1) Number Required: Two
    - 2) Mounting: Centered between bowls.
  - e. Supplies: NPS 1/2 chrome-plated copper with stops or shutoff valves.
  - f. Drain Piping: NPS 2" DWV copper piped indirectly to floor sink.



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2.9 LAVATORIES

A. Lavatories, (P-3):

1. Description: Counter top, vitreous china. Basis of design American Standard Lucerne model 0355.027 or a model by one of the following.
  - a. Type: Counter top.
  - b. Faucet Hole Punching: 4" center.
  - c. Faucet: Sensor
  - d. Supplies: NPS 3/8 chrome-plated copper with stops.
  - e. Drain: Grid.
  - f. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; NPS 1-1/2 thick tubular brass waste to wall; and wall escutcheon.
  - g. Protective Shielding Guard(s): PSG-A.

2.10 SERVICE BASINS

A. Mop Receptor, (P-4):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Fiat model TSBC-1610 or a comparable product by one of the following:
  - a. Acorn Engineering Company.
  - b. Crane Plumbing, L.L.C./Fiat Products.
  - c. Florestone Products Co., Inc.
  - d. Precast Terrazzo Enterprises, Inc.
  - e. Stern-Williams Co., Inc.
2. Description: Flush-to-wall, floor-mounting, cast-polymer fixture with rim guard.
  - a. Shape: Square.
  - b. Size: 24 by 24 inches.
  - c. Height: 12 inches.
  - d. Tiling Flange: Not required.
  - e. Rim Guard: Stainless steel.
  - f. Faucet: Sink: Delta 28T9.
  - g. Drain: Grid with NPS 3 outlet.
  - h. Mop Hanger: Fiat 889-CC.
  - i. Hose Bracket: Fiat 832-AA.
  - j. Wall Guard: Stainless steel MSG2424.

2.11 OUTDOOR BOTTLE FILLING STATION (P-9)

1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay Outdoor ezH2O Model LK4420BF1UFRK or a compatible product by one of the following:
  - a. Halsey Taylor
  - b. Oasis
  - c. Sunroc Corp.

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2. Description: Outdoor upper bottle filling station, bi-level Pedestal non-filtered non-refrigerated freeze resistant.
  - a. No electric required
  - b. Floor mounted/free standing
  - c. Vandal resistant bubbler
  - d. Dimensions: 14" x 31" x 64"
  - e. Install location: Outdoor
  - f. Filter: add in-line filter, certified to NSF 42 and 53 for lead, cyst, particulate, chlorine, taste and odor reduction.
  - g. Accessories: direct bury adaptor.

### 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 back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- C. Install wall-mounting fixtures with tubular waste piping attached to supports.
- D. Install fixtures level and plumb according to roughing-in drawings.
- E. 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, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- F. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- G. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- H. 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.

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- I. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- J. 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.
- K. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
  - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- L. 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 "Common Work Results for Plumbing."
- M. 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. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

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- C. Replace washers and seals of leaking and dripping faucets and stops.
- D. 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 224000

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 Water Cooler: Fixture that can be approached and used by people with disabilities.
- B. Fitting: Device that controls flow of water into or out of fixture.
- C. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

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.

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- 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.

#### 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. Filter Cartridges: Equal to 50 percent of amount installed for each type and size indicated, but no fewer than 2 of each.

### PART 2 - PRODUCTS

#### 2.1 PRESSURE WATER COOLERS

- A. Water Cooler with Bottle Fill, (P-8):
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay model LZSG8WSSK water cooler with bottle filling station or a comparable product by one of the following:
    - a. Halsey Taylor.
    - b. Oasis Corporation.
    - c. Sunroc Corp.
  - 2. Description: ARI 1010, Type PB, pressure with bubbler, with bottle filling station.
    - a. Cabinet: Stainless steel with stainless-steel top.
    - b. Bubbler: One, with adjustable stream regulator, located on deck.
    - c. Control: Push button.
    - d. Supply: NPS 3/8 with ball, gate, or globe valve.
    - e. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
    - f. Drain: Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.2.
    - g. Cooling System: Electric, hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
      - 1) Capacity: 8 gph of 50 deg F cooled water from 80 deg F inlet water and 90 deg F ambient air temperature.
      - 2) Electrical Characteristics: 1/4 hp; 115-V ac; single phase; 60 Hz.

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## 2.2 FIXTURE SUPPORTS

- 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. Josam Co.
  - 2. MIFAB Manufacturing, Inc.
  - 3. Smith, Jay R. Mfg. Co.
  - 4. Tyler Pipe; Wade Div.
  - 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
  - 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- C. 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. Type II: Bilevel, hanger-type carrier with three vertical uprights.
  - 3. 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 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 mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.

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- C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- D. 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."
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. 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 "Common Work Results for Plumbing."
- G. 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."

### 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.



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- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 224700

SECTION 226600 - CHEMICAL-WASTE SYSTEMS FOR LABORATORY FACILITIES

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 piping.
  - 2. Piping specialties.
  - 3. Neutralization tanks.

1.3 DEFINITIONS

- A. FPM: Vinylidene fluoride (hexafluoro propylene copolymer rubber).

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) 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. Pipe sizes, locations, and elevations.
  - 2. Other piping in same trench and clearances from sewerage system piping.
  - 3. Interface and spatial relationship between piping and proximate structures.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For chemical-waste specialties to include in emergency, operation, and maintenance manuals.

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1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties with sealing plugs in ends or with end protection.
- B. Do not store plastic pipe or fittings in direct sunlight.
- C. Protect pipe, fittings, and seals from dirt and damage.

1.8 FIELD CONDITIONS

- A. Interruption of Existing Chemical-Waste Service: Do not interrupt chemical-waste service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary chemical-waste service according to requirements indicated:
  - 1. Notify Owner no fewer than 5 days in advance of proposed interruption of chemical-waste service.
  - 2. Do not proceed with interruption of chemical-waste service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Single-Wall Piping Pressure Rating: 5-psig air test pressure.

2.2 PIPING SPECIALTIES

- A. Corrosion-Resistant Traps:
  - 1. Type: P-trap or drum trap.
  - 2. Size: NPS 1-1/2 or NPS 2, as required to match connected piping.
  - 3. PVDF: ASTM D 3222, with mechanical-joint pipe connections.
  - 4. Standard: ASTM A 861.
- B. Stainless-Steel Cleanouts:
  - 1. Standard: ASME A112.3.1, ASTM A 666, Type 316L stainless steel.
  - 2. Aboveground Piping: Cleanout tee of size matching piping.
  - 3. Underground and Underslab Piping: Floor access cleanout of size matching piping.
- C. Stainless-Steel Floor Drains (FD-C), Basis of design, Jay R. Smith 9600Y.
  - 1. Standard: ASME A112.3.1, ASTM A 666, Type 316L.
  - 2. Body: With 6 inch diameter top with grate.
  - 3. Outlet: Bottom, 3".

2.3 NEUTRALIZATION TANKS

- A. Plastic Neutralization Tanks:

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1. Basis-of-Design Product: Subject to compliance with requirements, provide Schier LB-2 tank, or a comparable product by one of the following:
  - a. Chem-Tainer Industries.
  - b. IPEX Inc.
  - c. Watts Industries (Canada) Inc.
2. Description: Corrosion-resistant plastic materials; with removable, gastight cover; interior, sidewall, dip-tube inlet; outlet; vent; and threaded or flanged, sidewall pipe connections.
  - a. Material: ASTM D 4101, PP.
  - b. Tank Capacity: 2 Gallon.
  - c. Dip Tube: On outlet pipe instead of inlet pipe.
  - d. Extension: HDPE, PE, or PP.
  - e. Limestone: Chips or lumps, with more than 90 percent calcium carbonate content and 1- to 3-inch diameter.

### PART 3 - EXECUTION

#### 3.1 PIPING INSTALLATION

##### A. Chemical-Waste Piping Inside the Building:

1. Install piping next to equipment, accessories, and specialties to allow service and maintenance.
2. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.
3. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
4. 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.
5. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
6. Install piping at indicated slopes.
7. Install piping free of sags and bends.
8. Install fittings for changes in direction and branch connections.
9. Verify final equipment locations for roughing-in.
10. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
11. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
12. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

#### 3.2 PIPING SPECIALTY INSTALLATION

- A. Fasten grates to drains if indicated.
- B. Set floor drains with tops flush with pavement surface.

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### 3.3 HANGER AND SUPPORT INSTALLATION

- A. Pipe sizes in this article refer to aboveground single-wall piping.
- B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:
  - 1. Vertical Piping: MSS Type 8 or MSS Type 42 riser clamps.
  - 2. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
  - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 4. Base of Vertical Piping: MSS Type 52 spring hangers.
- C. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for installation of supports.
- D. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- E. Support vertical piping and tubing at base and at each floor.
- F. Rod diameter may be reduced one size for double-rod hangers, to minimum of 3/8 inch.
- A. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4: 36 inches with 3/8-inch rod.
  - 2. NPS 1-1/2 and NPS 2: 42 inches with 3/8-inch rod.
  - 3. NPS 2-1/2 and NPS 3: 42 inches with 1/2-inch rod.
  - 4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
- B. Install supports for vertical CPVC piping every 48 inches.

### 3.4 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Make connections to existing piping, so finished Work complies as nearly as practical with requirements specified for new Work.
- C. Protect existing piping to prevent concrete or debris from entering while making connections. Remove debris or other extraneous material that may accumulate.
- D. Install piping adjacent to equipment to allow service and maintenance.

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3.5 FIELD QUALITY CONTROL

- A. Inspect interior of sewerage piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place and again at completion of Project.
  - 1. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between inspection points.
    - 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. Crushed, broken, cracked, or otherwise damaged piping.
    - d. Hydrostatic Tests for Drainage Piping:
      - 1) Allowable leakage is a maximum of 50 gal./inch of nominal pipe size per mile of pipe during 24-hour period.
      - 2) Close openings in system and fill with water.
      - 3) Purge air and refill with water.
      - 4) Disconnect water supply.
      - 5) Test and inspect joints for leaks.
    - e. Air Tests for Drainage Piping: Comply with UNI-B-6.
  - 2. Leaks and loss in test pressure constitute defects that must be repaired.
  - 3. Submit separate reports for each test.
- B. Replace leaking sewerage piping using new materials, and repeat testing until leakage is within allowances specified.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 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.
- E. Chemical-waste piping will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust neutralization-system set points.
- B. Adjust leak-detection-system control and device settings.

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3.7 CLEANING

- A. Use procedures prescribed by authorities having jurisdiction or, if not prescribed, use procedures described below:
  - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  - 2. Clean piping by flushing with potable water.

3.8 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below unless otherwise indicated.
- B. Aboveground Chemical-Waste Piping: Use the following piping materials for each size range:
  - 1. NPS 1-1/2 to NPS 4: PVDF drainage piping and socket fusion joints.

END OF SECTION

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SECTION 230000 – SUMMARY OF WORK

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions Specification Sections, apply to this Section.
- B. The requirements of all other sections of Division 23 apply to this section.

1.2 WARRANTY FOR PROJECT

- A. The Contractor shall provide the Owner with a minimum 2-year warranty on all equipment, materials, labor and systems from the date of Substantial Completion. The date of Substantial completion will be as set in a letter issued by the Architect – no exceptions.

1.3 DEFINITIONS

- A. For a complete list of definitions for this contract refer to the Division 1 specifications.
- B. Provide: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.
- C. Install: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.

1.4 SCOPE OF WORK

- A. The following description of work will use the following abbreviations:
  - 1. General Contractor – GC
  - 2. Electrical Contractor – EC
  - 3. Mechanical Contractor (HVAC) – MC
  - 4. Plumbing Contractor – PC
- B. Work Included: It is the intent of these specifications and the accompanying drawings that the Contractor shall, unless otherwise specified herein, furnish all labor, materials, tools, and equipment necessary, together with the necessary accessories to constitute a satisfactory and complete installation, to complete the installation of the mechanical work, as indicated on the drawings and described hereinafter. The Contractor shall properly install, equip, adjust and put in perfect condition, the respective portions of the work specified, and to so interconnect the various items or sections of the work to form a complete and properly operating whole. The work shall consist of, but shall not necessarily be limited to the following:
  - 1. For detailed scope of work for each mechanical system, refer to the respective Division 23 specification sections.
  - 2. Remove existing roof top units and all associated controls and ductwork.
  - 3. Remove existing cabinet unit heaters and all associated controls and supports.

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4. Provide, place and anchor all roof curbs and coordinate locations with the General Contractor. General Contractor is responsible for flashing and creating roof penetrations.
  5. Provide and install new split system air conditioning units variable refrigerant flow units and all associated hangers, supports, refrigerant piping, insulations, controls and wiring.
  6. Provide and install new dedicated outside air roof top units all associated curbs, ductwork, controls and wiring.
  7. Provide and install new radiant ceiling panels and all associated hangers, supports, controls and wiring.
  8. Provide and install new electric unit heaters, electric wall heater and all associated hangers, supports and controls.
  9. Provide and install new exhaust fans and associated ductwork, supports, dampers, grilles, roof curbs, and controls and wiring.
  10. Provide and install new electric unit heaters and all associated hangers, supports, controls and wiring.
  11. Provide all water heater venting and associated hangers and supports.
  12. Provide all new piping, ductwork, & equipment insulation.
  13. Provide complete system balancing at the completion of the project per contract specifications.
  14. Provide, place and anchor all roof curbs and coordinate locations with the General Contractor. General Contractor is responsible for flashing and creating roof penetrations.
  15. Provide all associated control equipment required unless otherwise noted.
  16. Providing all necessary permits, approvals, fees, etc.
  17. Provide instructions to the owner as outlined in these Specifications.
  18. Provide all cutting and patching as required to perform the work of this contract. Refer to architectural documents for additional requirements for patching.
  19. Provide all necessary rigging as required to perform the work of this contract.
  20. Provide manufacturer startup for all systems specified as outlined in these Specifications.
  21. Provide removal of trash and general clean-up.
  22. Provide as-built drawings.
  23. Provide operation and maintenance manuals.
  24. Employ the services of the local Underwriters' Inspection Agency and pay for all associated fees.
  25. Completion Date: All HVAC work shall be completed on the date of substantial completion for the project as set in the Division 1 specifications.
- C. The work shall include all materials, equipment and systems shown on the drawings and work for other Divisions required to complete all the work ready for operation.
- D. The Contractor shall provide all labor, material, equipment and services for the complete and proper installation and operation of the electrical work as indicated, required or implied by the drawings and as specified herein.
- E. All of the specifications listed and all of the drawings listed are part of the Contract Documents of the Contractor. The Contractor shall review all drawings and specification divisions to determine the full scope of his work.
- F. It will be the responsibility of the Contractor to examine all Drawings (Architectural, Structural, Mechanical, Electrical and Plumbing) to determine the full extent of the work. All field measurements and verifications of conditions and materials will be the obligation of the Contractor. The submission of a Proposal by the Contractor will be considered an indication that all work, in compliance with these specifications and the drawings, has been included in the Proposal. It will also be considered an indication that a thorough review of conditions, materials, and all related specifications have been investigated by the Contractor, and the results of such investigations have been included in the

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Contractor's Proposal.

- G. All shutdowns of any building system, including but not limited to, air handling systems, hot water, chilled water and gas service shall be coordinated with the owner minimum 14 days prior to shut down.
- H. If the mechanical contractor chooses to substitute (even for equal products listed in the specifications) products relative to the basis-of-design system/manufacturer listed on the drawings and/or in the specifications, the mechanical contractor is responsible to pay the electrical and plumbing contractors for any modifications needed with circuit breakers, wiring or piping for the substituted mechanical product and/or system. If the mechanical contractor does not want to accept the responsibility and risk for compensating the other contractors, then the basis of design products/systems should be used.
- I. Coordination Between Mechanical (MC) and Electrical (EC) Contractors:
  - 1. The Electrical Contractor shall:
    - a. Receive and set the motor starters as provide by the Mechanical and Plumbing Contractors.
    - b. Provide power wiring, including final connection of same, from source to starters or contactors to motors.
    - c. Receive and install the wall-mounted electrical control devices, thermal switches, etc., and provide all wiring for same.
    - d. Provide all fused or unfused disconnect switches and circuit breakers not supplied as part of the HVAC system and as required by the National Electrical Code, or as shown on the drawings, or as specified.
    - e. Adjust connections to electrical motors to insure proper rotation.
    - f. Provide duct detectors and air sampling tubes to the MC for installation in the ductwork. EC shall wire and program the duct detectors and remote test stations into the fire alarm system. MC shall wire the duct detector shut-down into the BAS system.
    - g. Provide 120V to junction boxes for the MC provided 120-24V transformers. EC to receive the transformer from the MC and install & wire up the 120V side of the transformer. MC shall provide all 24V wiring.
    - h. Provide 120V to the MC provide duct smoke dampers. Control of the smoke dampers shall be via the EC provided fire alarm system.
  - 2. The Mechanical Contractor will:
    - a. Furnish and set all motors for mechanical equipment.
    - b. Furnish all motor starters, VFDs, starter/disconnects, HVAC unit mounted disconnects, contactors, pushbuttons and switches for local and remote control of all HVAC equipment and turn over to the Electrical Contractor for installation.
    - c. Provide pre-wired control panels, including relays, switches, pilot lights, etc., all as shown and/or specified, complete with wiring to numbered terminal strips.
    - d. Furnish and install duct and pipe-mounted control devices, such as freezestats, aquastats, flow switches, etc.
    - e. Furnish wiring diagrams for the systems, in sufficient time to allow roughing-in of conduit in accordance with the proposed work schedule.
    - f. Provide the 120-24V transformers for the VAVs to the EC for installation and wiring. MC shall provide all 24V wiring.
    - g. For HVAC controls, the MC or their controls sub-contractor is responsible to provide all control wiring including 120V controls, 120V power to controls cabinets, 120V power and 120/24V control power transformers as required for a complete and fully functional system. EC will install the main power feeds to each piece of HVAC equipment only.

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- h. Provide all data CAT6 cabling, as required, for the HVAC controls equipment and systems from the nearest IDF or MDF closet. MC shall hire the EC's low-voltage sub-contractor to perform this work for consistency.
  - i. Receive duct detectors and air sampling tubes from the EC and install in the ductwork. MC shall provide and install all shut-down and system activation wiring from the smoke detectors to the respective units.
- 3. The Plumbing Contractor will:
  - a. Furnish and set all motors for plumbing equipment.
  - b. Coordinate locations of all equipment with both the Mechanical and Electrical Contractors.
  - c. Provide the Electrical Contractor with information and instructions for connection of electrical service to water coolers, domestic hot water heater, etc.
  - d. Provide and install flow switches for the fire protection system. EC to provide monitoring of the switches in the fire alarm system.
- 4. The Electrical Contractor shall examine the drawings and read the specifications for the mechanical trades, and shall note all motor-driven equipment, starters and control apparatus noted, shown or specified herein.

#### 1.5 WARRANTY

- A. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion. It will not make any difference when equipment is ordered, delivered or installed, warranties will commence after the Architect issues his letter of "Substantial Completion."
- B. All equipment is to include factory start-up unless the Contractor receives written permission, from the owner, for Contractor start-up. Copies of the start-up report must be included with the Request for Final Payment, otherwise final payment will be withheld until the factory reports are submitted.
- C. All equipment furnished under this contract, including the DDC system, will include a two-year warranty on parts and labor. Warranties will begin after Substantial Completion. The date of Substantial completion will be as set in a letter issued by the Architect – no exceptions.

#### 1.6 OCCUPANCY

- A. Full Owner Occupancy: The Owner will occupy the site and building during the entire construction period. Coordinate with the Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with the Owner's operations

PART 2 - PRODUCTS (Not applicable).

PART 3 - EXECUTION (Not applicable).

**END OF SECTION**

SECTION 230500 – 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. Dielectric fittings.
  - 3. Mechanical sleeve seals.
  - 4. Sleeves.
  - 5. Escutcheons.
  - 6. Grout.
  - 7. Equipment installation requirements common to equipment sections.
  - 8. Painting and finishing.
  - 9. Supports and anchorages.
  - 10. Roof penetration housings

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, crawlspace, 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.

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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.

H. References

1. ICC-500, FEMA 320/361 – Third Party Tested to +225 mph
2. ICC 2015 Energy Code – Third Party Tested to ASTM E 2078-13 Standard Test Method for Air Permeance of Building Materials
3. ASTM E 1980 Solar Reflectance Index (SRI)

#### 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. 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.

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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 08 Section "Access Doors and Frames."

1.8 CODES AND STANDARDS FOR WELDING

- A. The following codes and standards are to be followed for all welding performed on this project:
  - 1. ASME Section IX Boiler and Pressure Vessel Code
  - 2. AWS D1.1, "Structural Welding Code--Steel."
  - 3. AWS D10.12, "Guide for Welding Mild Steel Pipe."
  - 4. ASME B31 Series, "Code for Pressure Piping."

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.



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- 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, carbon 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, BAgl, 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 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 Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
  - 1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Eclipse, Inc.
    - d. Epco Sales, Inc.
    - e. Watts Industries, Inc.; Water Products Div.
    - f. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
  - 1. Manufacturers:

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- a. Capitol Manufacturing Co.
  - b. Central Plastics Company.
  - c. Epco Sales, Inc.
  - d. Watts Industries, Inc.; Water Products Div.
- E. 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 minimum working pressure where required to suit system pressures.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
  - 1. Manufacturers:
    - a. Perfection Corp.
    - b. Precision Plumbing Products, Inc.
    - c. Sioux Chief Manufacturing Co., Inc.
    - d. Victaulic Co. of America.

## 2.5 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: 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.

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2.6 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. 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.

2.7 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.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.8 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.

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## 2.9 ROOF PENETRATION HOUSINGS

### A. Description: Pipe and duct roof penetration housing.

#### 1. Manufacturers:

- a. Roof Penetration Housings, San Antonio, Texas  
1) 1-800-994-0945, TomK@Roofpenetrationhousings.com or
- b. Equal as approved by the engineer

### B. The Vault

#### 1. Product: The Vault® Model AW by Roof Penetration Housings:

- a. All Aluminum 3rd-party tested for wind and ICC2018 Air Permeance and Insulated Curb code compliance. Vault® to carry an insured 20-yr. warranty against leaks. Units shall include Series 5000 aluminum exit seals with Silx14 gasket, or Series 6000 & 7000 Stainless steel frame with Silx14 gaskets, for various types of penetrant's, including, but not limited to, duct work, electrical outlets, electrical conduit, communication cables, refrigeration lines, & solar lines.
- b. Exit seals - Each contractor trade (HVAC, Electrical, Plumbing, etc) shall provide the appropriate exit seals for their specific level of responsibility
- c. Equal products with 20 year warranty/insurance certificate and 3rd party testing for ICC 2018 Compliance and Wind rating, will be acceptable.
- d. The contractor shall supply Vault® 20 year warranty/insurance certificate and 3rd party certification, for Wind and ICC 2018 compliance, along with Vault® submission for approval.

#### 2. Construction:

- a. 0.080 inch (2mm) thick aluminum housing and curb
- b. UV protected powder coated finish (2 mil (.05 mm) thick)
- c. Stainless Steel. V.P. fasteners
- d. Gasketed lid to housing and housing to curb connection joints to ensure compliance to ICC 2015 Air Permeance Levels
- e. Standard Color: Beige – To meet an initial SRI of 85 (White available for SRI 100)
- f. Constructed to withstand wind to 225+ MPH, third party tested.

#### 3. Style & Sizes: AW Series

- a. Small Vault®  
Model: AW-161010  
L- 16 ½" W- 9 ¾" H- 10"  
Designed to small AC Condensing Units up to 7 ½ tons. Accommodates up to 1.9 OD pipes/conduits/telecommunication cables. Designed for a power conduit, control conduit, liquid line and suction line.
- b. Medium Vault®  
Model: AW-201412  
L- 20 ½" W- 14 ½" H – 12"  
Accommodates multiple pipes/conduit/telecommunication cables to the roof. Designed for 4 condensing units (two on each side) up to 16 Series 5000 Exit Seals
- c. Mega Vault®  
Model: AW-343424  
L – 34" W – 34" H – 24"  
Allows for a wide variety of installation choices, including multiple AC units, larger pipe diameters, large electrical disconnects and ducts up to 30+ Series 5000 Exit Seals
- d. Custom Size– Consult Factory

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4. Exit Seals
  - a. Design: Weather tight seal for vertical surface/plane penetrations. Seal construction to be manufactured in all aluminum construction and 100% Sil-X-14 silicone gaskets.
    - 1) Series 5000 - .25" to 1.90"  
Series 6000 - 2" to 3.125"  
Series 7000 - 3.5" Large Diameter Double Gasketed inside and out
    - 2) Penetration Pipe Type as Applicable: Copper K and L, copper ACR, steel Schedule 40, PVC Schedule 40 and 80, electrical EMT, electrical rigid, aluminum, liquid light, and A/C or Plumbing Ducts

### PART 3 - EXECUTION

#### 3.1 DEMOLITION

- A. Refer to Division 10000 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove Mechanical 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 and cap or plug piping with same or compatible piping material.
  3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
  4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
  5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. 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 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.

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- 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, stamped-steel type.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
    - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
    - g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
    - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. 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 of mechanical equipment areas or other wet areas 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 large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

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- a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
  - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, 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 above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
    - 1) Seal space outside of sleeve fittings with grout.
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.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  3. 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. 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 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.
- S. 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.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- 3.3 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.

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- 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. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  - 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

### 3.4 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. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.



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3.5 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 HVAC 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.

3.6 PAINTING

- A. Painting of HVAC 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.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

- A. Mix and install grout for HVAC 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.

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**END OF SECTION**

SECTION 230513 – 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.

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.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet 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.

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### 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy 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 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.
  - 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. Energy- and 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.
- B. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

### 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.

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2. Split phase.
  3. Capacitor start, inductor run.
  4. Capacitor start, capacitor run.
- 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.
- 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.

PART 3 - EXECUTION (Not Applicable)

**END OF SECTION**

SECTION 230529 – 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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following hangers and supports for HVAC system piping and equipment:

- 1. Steel pipe hangers and supports.
- 2. Trapeze pipe hangers.
- 3. Metal framing systems.
- 4. Thermal-hanger shield inserts.
- 5. Fastener systems.
- 6. Pipe stands.
- 7. Equipment supports.

- B. Related Sections include the following:

- 1. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

- A. Product Data: For the following:

- 1. Steel pipe hangers and supports.
- 2. Thermal-hanger shield inserts.
- 3. Powder-actuated fastener systems.

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- B. Welding certificates.

## 1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

## 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 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
  - 1. AAA Technology & Specialties Co., Inc.
  - 2. Bergen-Power Pipe Supports.
  - 3. B-Line Systems, Inc.; a division of Cooper Industries.
  - 4. Carpenter & Paterson, Inc.
  - 5. Empire Industries, Inc.
  - 6. ERICO/Michigan Hanger Co.
  - 7. Globe Pipe Hanger Products, Inc.
  - 8. Grinnell Corp.
  - 9. GS Metals Corp.
  - 10. National Pipe Hanger Corporation.
  - 11. PHD Manufacturing, Inc.
  - 12. PHS Industries, Inc.
  - 13. Piping Technology & Products, Inc.
  - 14. Tolco Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

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2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
1. B-Line Systems, Inc.; a division of Cooper Industries.
  2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
  3. GS Metals Corp.
  4. Power-Strut Div.; Tyco International, Ltd.
  5. Thomas & Betts Corporation.
  6. Tolco Inc.
  7. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
1. Carpenter & Paterson, Inc.
  2. ERICO/Michigan Hanger Co.
  3. PHS Industries, Inc.
  4. Pipe Shields, Inc.
  5. Rilco Manufacturing Company, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.



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2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: 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.
  - 1. Manufacturers:
    - a. Hilti, Inc.
    - b. ITW Ramset/Red Head.
    - c. Masterset Fastening Systems, Inc.
    - d. MKT Fastening, LLC.
    - e. Powers Fasteners.

2.7 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support pad-mounted piping.
- B. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller.
- C. High-Type, Single-Pipe Stand:
  - 1. Description: Assembly of base, vertical and horizontal members, and pipe support.
  - 2. Base: Stainless steel.
  - 3. Vertical Members: Two or more stainless-steel, continuous-thread rods.
  - 4. Horizontal Member: Stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- D. High-Type, Multiple-Pipe Stand:
  - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
  - 2. Bases: One or more; stainless steel.
  - 3. Vertical Members: Two or more stainless steel channels.
  - 4. Horizontal Member: stainless steel channel.
  - 5. Pipe Supports: Stainless steel, clevis-type pipe hangers.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, 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, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified 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 on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. 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.
  - 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
  - 3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
  - 4. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  - 5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
  - 6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
  - 7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
  - 8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
  - 9. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
  - 10. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
  - 11. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
  - 12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  - 13. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
- G. 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 20.
  - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

- H. 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 for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. 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.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  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.
- J. 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.

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- K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete 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 smooth bearing surface.
- 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 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 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.

### 3.5 PAINTING

- A. Touch Up: 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**

SECTION 230553 – 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.

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PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch, Stainless steel, 0.025-inch, Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, 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.

C. 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.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch 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, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: Yellow.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

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- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, 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, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. 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 high.

## 2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Blue.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, 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.



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- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label 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 high.

## 2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: Brass, 0.032-inch, Stainless steel, 0.025-inch, Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch 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: 3 by 5-1/4 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.

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- B. Locate equipment labels where accessible and visible.

### 3.3 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
  - 1. Blue: For cold-air supply ducts.
  - 2. Yellow: For hot-air supply ducts.
  - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
  - 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

### 3.4 PIPE LABEL INSTALLATION

- A. 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 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
  - 1. Refrigerant Piping:
    - a. Background Color: Black.
    - b. Letter Color: White.

### 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. Refrigerant: 1-1/2 inches, round.

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2. Valve-Tag Color:
  - a. Refrigerant: Natural.
3. Letter Color:
  - a. Refrigerant: Black.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

**END OF SECTION**

SECTION 230593 – 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.

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. 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.

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1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by NEBB.
  - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by NEBB.
  - 2. TAB Technician: Employee of the TAB contractor and who is certified by NEBB as a TAB technician.
- B. 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.
- C. TAB Report Forms: Use standard TAB contractor's forms approved by Commissioning Authority.
- D. 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 existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 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.

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- 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 variable-air-volume boxes, 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.

### 3.2 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. Automatic temperature-control systems are operational.
  - 3. Equipment and duct access doors are securely closed.
  - 4. Balance, smoke, and fire dampers are open.
  - 5. Isolating and balancing valves are open and control valves are operational.

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6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
7. Windows and doors can be closed so indicated conditions for system operations can be met.

### 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in 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, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
  2. 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.

### 3.4 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.

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- L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

### 3.5 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, heat-recovery equipment, and air washers, 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 Engineer 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.



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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.

### 3.6 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: 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.

### 3.7 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

### 3.8 TOLERANCES

- A. Set HVAC system's air flow rates within the following tolerances:
  1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
  2. Air Outlets and Inlets: Plus or minus 10 percent.

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3.9 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.

3.10 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 distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
  2. Duct, outlet, and inlet sizes.
  3. Pipe and valve sizes and locations.
  4. Terminal units.
  5. Balancing stations.
  6. 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, and bore.
    - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    - 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, and bore.
    - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
  3. Test Data (Indicated and Actual Values):
    - a. Total air flow rate in cfm.
    - b. Total system static pressure in inches wg.
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg.

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- e. Filter static-pressure differential in inches wg.
- f. Preheat-coil static-pressure differential in inches wg.
- g. Cooling-coil static-pressure differential in inches wg.
- h. Heating-coil static-pressure differential in inches wg.
- i. Outdoor airflow in cfm.
- j. Return airflow in cfm.
- k. Outdoor-air damper position.
- l. Return-air 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 o.c.
- f. Make and model number.
- g. Face area in sq. ft..
- h. Tube size in NPS.
- i. Tube and fin materials.
- j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm.
- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
- e. Return-air, wet- and dry-bulb temperatures in deg F.
- f. Entering-air, wet- and dry-bulb temperatures in deg F.
- g. Leaving-air, wet- and dry-bulb temperatures in deg F.
- h. Refrigerant expansion valve and refrigerant types.
- i. Refrigerant suction pressure in psig.
- j. Refrigerant suction temperature in deg F.

G. 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, and bore.
- h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

- a. Motor make, and frame type and size.

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- b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    - g. Number, make, and size of belts.
  - 3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Total system static pressure in inches wg.
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg.
    - e. Suction static pressure in inches wg.
- H. 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.
    - d. Duct static pressure in inches wg.
    - e. Duct size in inches.
    - f. Duct area in sq. ft..
    - g. Indicated air flow rate in cfm.
    - h. Indicated velocity in fpm.
    - i. Actual air flow rate in cfm.
    - j. Actual average velocity in fpm.
    - k. Barometric pressure in psig.
- I. Air-Terminal-Device Reports:
  - 1. Unit Data:
    - a. System and air-handling unit identification.
    - b. Location and zone.
    - c. Apparatus used for test.
    - d. Area served.
    - e. Make.
    - f. Number from system diagram.
    - g. Type and model number.
    - h. Size.
    - i. Effective area in sq. ft..
  - 2. Test Data (Indicated and Actual Values):
    - a. Air flow rate in cfm.
    - b. Air velocity in fpm.
    - c. Preliminary air flow rate as needed in cfm.
    - d. Preliminary velocity as needed in fpm.
    - e. Final air flow rate in cfm.

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- f. Final velocity in fpm.
- g. Space temperature in deg F.

J. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.11 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 10 percent of air outlets.
  - b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
  - c. Verify that balancing devices are marked with final balance position.
  - d. 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 Commissioning Authority.
- 2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Commissioning Authority.
- 3. 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.

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- D. Prepare test and inspection reports.

3.12 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**

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SECTION 230700 – 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. Adhesives.
- 3. Mastics.
- 4. Lagging adhesives.
- 5. Sealants.
- 6. Factory-applied jackets.
- 7. Field-applied jackets.
- 8. Tapes.
- 9. Securements.

B. Related Sections:

- 1. 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.



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- 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 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.

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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. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. 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.
- F. 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 III with factory-applied FSP 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. Manson Insulation Inc.; Alley Wrap.
    - e. Owens Corning; All-Service Duct Wrap.
- G. 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 FSK jacket. For equipment applications, provide insulation with factory-applied FSK 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.; 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.
- H. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Products: Subject to compliance with requirements, provide one of the following:

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- 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 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.
3. Conductivity: 0.28 Btu\*in./(h\*ft2 °F)
- 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. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville.
    - b. Knauf Insulation.
    - c. Owens Corning.

## 2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 1-hour and 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; FlameChek.
    - b. Johns Manville; Firetemp Wrap.
    - c. Morgan Advanced Materials; FireMaster FastWrap XLS .
    - d. 3M; Fire Barrier Wrap Products.

## 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 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.

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- 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.
- 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.

## 2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- 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 at 43-mil dry film thickness.
  - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
  - 5. Color: White.
- C. 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.

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2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
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. 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.
  2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
  3. Service Temperature Range: Minus 50 to plus 180 deg F.
  4. 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.
5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

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. 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.
5. Color: White.

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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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 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, and mechanical joints..
  5. Factory-fabricated tank heads and tank side panels.
- C. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with stucco-embossed aluminum-foil facing.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Polyguard Products, Inc.; Alumaguard 60.
- D. Outdoor insulation PVC Jacket: Insulation Protector for Refrigeration Piping on Outdoor applications that complies with mandatory requirements. Engineered PVC Material is UV/Weather Resistant and a Class II Vapor Retarder. Insulation Protection System consists of an Engineered and Formulated PVC Sheeted Material to Specifically protect outdoor piping insulation, it is designed and manufactured as a flexible PVC jacket, with a permanent non-adhesive dual bonded self-gripping integral fastening system. The fastening system allows the protector to be Removable and Reusable for ease of Maintenance, as required by code bodies. The Insulation Protector consists of resilient PVC Material that is Class "A" Fire/Smoke Rated, Vapor Retarder, Anti-Fungal, and Anti-Microbial.

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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. Airex: Eflexguard.
  - b. Childers Products, Division of ITW
  - c. Foster Products Corporation
  - d. Or Approved Equal
2. Adhesive: As recommended by jacket material manufacturer.
3. Color: Black.
  - a. Shapes: 90-degree, short- and long-radius elbows, mechanical joints.
4. Comply with ASTM E96 and ASTM G153.

2.9 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.
  3. Thickness: 11.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch 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.
  3. Thickness: 6.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

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- 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.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

## 2.10 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 thick, 3/4 inch wide with wing seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal.

- 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-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-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch 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.



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- 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 thick by 2 inches square.
  - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-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 thick by 1-1/2 inches in diameter.
  - c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
  - 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 thick by 2 inches square.
  - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-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-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

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- 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-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches 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-wide, stainless steel or Monel.
- D. Wire: 0.062-inch 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.

### 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:

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1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. 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 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.

### 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:

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1. Draw jacket tight and smooth.
  2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. 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 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 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.

### 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 below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. 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.

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4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. 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.
  1. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.
- E. Insulation Installation on Pumps:
  1. 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 centers, starting at corners. Install 3/8-inch diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
  2. Fabricate boxes from stainless steel, at least 0.040 inch 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.

### 3.5 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.

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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. 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 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.

### 3.6 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.

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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.

3.7 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 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, 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.

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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 and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches 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 from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch 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 at 18-foot 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.
  5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches 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-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches 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:



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- a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
  - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches 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 from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch 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 at 18-foot 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.
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-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.8 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 using UL Listed Through-Penetration Firestop Systems.

### 3.9 FIELD-APPLIED JACKET INSTALLATION

- A. Where metal jackets are indicated, install with 2-inch 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 o.c. and at end joints.

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- B. Where PVC jackets are indicated, install with 1-inch 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.

### 3.10 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

### 3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

- B. 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 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 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.

- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.12 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 located in nonconditioned space.
  - 4. Indoor, exposed return located in nonconditioned space.
  - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

- B. Items Not Insulated:

- 1. Fibrous-glass ducts.

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2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
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.

### 3.13 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Rectangular, supply-air duct and conditioned outside air duct insulation shall be one of the following:
  1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
  2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
- B. Round, supply-air duct and conditioned outside air duct insulation shall be one of the following:
  1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
  2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
- C. Rectangular, return-air duct air duct insulation shall be one of the following:
  1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
  2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
- D. Round, return-air duct air duct insulation shall be one of the following:
  1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
  2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
- E. Rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be one of the following:
  1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
  2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
- F. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket; thickness as required to achieve 2-hour fire rating.

### 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. Drainage piping located in crawl spaces.
  2. Underground piping.
  3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

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3.15 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F:
  - 1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
    - b. Flexible Elastomeric: 3/4 inch thick.
- B. Refrigerant Liquid, Suction and Hot-Gas Flexible Tubing for ductless split systems:
  - 1. Refer to specification Division 23 Section "Refrigerant Piping" for pre-insulated pipe sets.
- C. Refrigerant Suction, Liquid and Hot-Gas Flexible Tubing for VRF systems:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 1 inch thick.

3.16 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Refrigerant, Liquid, Suction and Hot-Gas Flexible Tubing: Refer to specification Division 23 Section "Refrigerant Piping" for pre-insulated pipe sets.
- B. Outdoor Refrigerant Suction, Liquid and Hot-Gas Flexible Tubing for VRF systems:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 1-1/8" inch thick Aeroflex Aerocel UV resistant insulation.

3.17 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. Refrigerant Piping, Exposed: Outdoor insulation PVC Jacket Airex Eflexguard or approved equal.

**END OF SECTION**

SECTION 230900 – INSTRUMENTATION & 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 1 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. Scope of work includes all work associated with new equipment controls, including but not limited to controllers and appurtenances not factory required and as required to meet the sequences of operation indicated on contract documents, as well as installation of all controls appurtenances shipped loose from factory, and all wiring, programming, and graphics for tie in to the existing Tri-M Schneider Electric EcoStruxure BMS system.
- C. Related Sections include the following:
  - 1. Division 23 Section "Meters and Gages" for measuring equipment that relates to this Section.

1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. LAN: Local Area Network

1.4 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. 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.

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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 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.
- C. Qualification Data: For Installer.
- D. Field quality-control test reports.
- E. 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 1 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.

#### 1.5 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.
- 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.

#### 1.6 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate supply of electrical branch circuits for control units.
- C. Coordinate equipment with Division 16 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

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1.7 WARRANTY.

- A. 2-year parts and service warranty.

1.8 SYSTEM/PROJECT REQUIREMENTS

- A. All zone thermostats as part of this contract shall have an LCD display screen with occupancy override unless otherwise noted. All remote standalone sensors (non-communication to building Supervisory Controller) shall be provided with Andover standalone thermostat with locking non-clear metal vented cover. Provide all thermostats in gymnasium in clear lockable vented enclosure.
- B. Provide unit scheduling function through Individual Building Supervisory Controllers. Scheduling shall be unit specific with the ability to group like units and zones.
- C. All controls shall be hard-wired, including all controllers and sensors. Wireless controls shall not be acceptable.

3.

PART 2 - PRODUCTS – Ecostruxture

2.1 System Architecture

A. General

- 1. The BAS shall provide control, alarm detection, scheduling, reporting and information management for the entire building, and interface with the Local Area Network (LAN) or Wide Area Network (WAN) as required.
  - 2. The Building Automation System (BAS) shall consist of:
    - a. Network Server/Controllers (NSCs),
    - b. Standalone Digital Control Units (SDCUs)
    - c. Administration and Programming Workstations (APWs)
    - d. Enterprise Server (ES)
    - e. Report Server (RS)
    - f. Web-based Operator Workstations (WOWs)..
  - 3. Where two or more NSCs are included, an Enterprise Server is required, which enables multiple NSCs (including all graphics, alarms, schedules, trends, programming, and configuration) to be accessible from Workstations simultaneously for operations and engineering tasks.
  - 4. The Enterprise Level BAS shall be able to host up to 250 Network Servers (NSCs) beneath it.
  - 5. For Enterprise reporting capability and robust reporting capability outside of the trend chart and listing ability of the Workstation, a Reports Server shall be installed on a Microsoft Windows SQL based computer. The Reports Server can be installed on the same computer as the Enterprise Server.
  - 6. The system shall be designed with a top-level 10/100bT Ethernet network, using the BACnet/IP, and/or Modbus TCP protocol.
- B. Modbus RTU, Modbus TCP, BACnet MS/TP, BACnet IP, and WebServices shall be native to the NSCs. There shall not be a need to provide multiple NSCs to support all the network protocols, nor should there be a need to supply additional software to allow these protocols to be natively supported.
  - C. A Fieldbus network of Standalone Digital Control Units (SDCUs) using the BACnet IP, BACnet MS/TP protocol shall connect the SDCUs with an Ethernet-level NSC using managed Ethernet switches where

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required. The NSC shall have a fixed IP address for connection the facility network and the SDCUs shall have separate, non-facility BACnet addresses assigned and managed by the NSC.

- D. BACnet IP Fieldbus SDCUs shall consist of one or more BACnet/IP field buses managed by the Network Server Controller. The field bus layer shall consist of up to 50 IP SDCUs in daisy chain topology, or 39 if using RSTP, per layer, with a max of 5 sub networks in daisy chain for a total of 250 SDCUs or 6 sub networks in RSTP for a total of 234 SDCUs.
- E. BACnet MS/TP Fieldbus SDCUs shall consist of one or more BACnet MS/TP field buses managed by the Network Server Controller. Minimum speed shall be 76.8kbps. The field bus layer consists of an RS485, token passing bus that supports up to 127 Standalone Digital Control Units (SDCUs) for operation of HVAC and lighting equipment. These devices shall conform to BACnet standard 135-2004. The NSCs shall be capable of at least two BACnet MS/TP field buses for a total capability of 254 SDCUs per NSC.
- F. BAS LAN Segmentation: The BAS shall be capable of being segmented, through software, into multiple local area networks (LANs) distributed over a wide area network (WAN). Workstations can manage a single LAN (or building), and/or the entire system with all portions of that LAN maintaining its own, current database.
- G. Standard Network Support: All NSCs, Workstation(s) and Servers shall be capable of residing directly on the owner's Ethernet TCP/IP LAN/WAN with no required gateways. Furthermore, the NSC's, Workstation(s), and Server(s) shall be capable of using standard, commercially available, off-the-shelf Ethernet infrastructure components such as routers, switches and hubs. With this design the owner may utilize the investment of an existing or new enterprise network or structured cabling system. This also allows the option of the maintenance of the LAN/WAN to be performed by the owner's Information Systems Department as all devices utilize standard TCP/IP components.
- H. Web Services: The installed system shall be able to use web services to "consume" information within the Network Server/Controllers (NSCs) with other products and systems. Inability to perform web services within the NSCs will be unacceptable. The NSC shall be able to "consume" data into the system via SOAP and REST web services
- I. System Expansion
  - 1. The BAS system shall be scalable and expandable at all levels of the system using the same software interface, and the same TCP/IP level and fieldbus level controllers. Systems that require replacement of either the workstation software or field controllers in order to expand the system shall not be acceptable.
  - 2. Web-based operation shall be supported directly by the NSCs and require no additional software.
  - 3. The system shall be capable of using graphical and/or line application programming language for the Network Server Controllers.
  - 4. All Network Server Controllers must natively support the open systems protocols of: BACnet IP, BACnet MS/TP, Modbus TCP and Modbus RTU protocols.

## 2.2 Operator Workstation Requirements

### A. General

- 1. The operator workstation portion of the BAS shall consist of one or more full-powered configuration and programming workstations, and one or more web-based operator workstations. For this project provide a minimum of 2 concurrent operator users and/or 1 concurrent engineering user.
- 2. The programming and configuration workstation software shall allow any user with adequate permission to create and/or modify any or all parts of the NSC and/or Enterprise Server database.
- 3. Web-based workstations shall have a minimum of 5 concurrent operator users.
- 4. All configuration workstations shall be personal computers operating under the Microsoft Windows operating system. The application software shall be capable of communication to all



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- Network Server Controllers and shall feature high-resolution color graphics, alarming, trend charting. It shall be user configurable for all data collection and data presentation functions.
5. A minimum of 2 physical Workstations shall be allowed on the Ethernet network. In this client/server configuration, any changes or additions made from one workstation will automatically appear on all other workstations since the changes are accomplished to the databases within the NSC.
- B. Workstation, Programming Workstation, and Enterprise Server Requirements:
1. Processor Intel Core i5 @ 3.0 GHz or better
  2. Memory: Minimum: 8GB RAM, 300 GB or larger hard disk, DVD drive
  3. Operating systems:
    - a. Microsoft Windows 10 64-bit (Pro or Enterprise)
    - b. Microsoft Windows Server 2008 R2 64-bit (Standard, Enterprise, Datacenter, Web, or Itanium)
    - c. Microsoft Windows Server 2012 or 2102 R2 or 2016 R2 64-bit (Standard, Datacenter, Essentials, or Foundation)
  4. 10/100MBPS Ethernet NIC
  5. SQL (Report Server only) Software - Microsoft SQL Server 2008 R2 with SP2 or 2012 64-bit (Standard and Express with Advanced Services)
  6. License agreement for all applicable software
- C. Web-Based Operator PC Requirements - Any user on the network can access the system, using Internet Explorer 11, or Mozilla Firefox, or Google Chrome
- D. System Software Architecture
1. System architecture shall be truly client server in that the Workstation shall operate as the client while the NSCs shall operate as the servers. The client is responsible for the data presentation and validation of inputs while the server is responsible for data gathering and delivery.
  2. The workstation functions shall include monitoring and programming of all DDC controllers. Monitoring consists of alarming, reporting, graphic displays, long term data storage, automatic data collection, and operator-initiated control actions such as schedule and setpoint adjustments.
  3. Programming of controllers shall be capable of being done either off-line or on-line from any programming workstation. All information will be available in graphic displays. Graphic displays will feature animation effects to enhance the presentation of the data, to alert operators of problems, and to facilitate location of information throughout the DDC system. All operator functions shall be selectable
  4. The software shall be designed so that each user of the software can have a unique username and password. This username/password combination shall be linked to a set of capabilities within the software, set by and editable only by, a system administrator. The sets of capabilities shall range from View only, Acknowledge alarms, Enable/disable and change values, Program, and Administer. The system shall allow the above capabilities to be applied independently to each and every class of object in the system. The system must allow a minimum of 256 users to be configured per workstation. Additionally, the software shall enable the ability to add/remove users based upon Microsoft Windows Security Domains that enable the customer IT department to assist in user access.
    - a. Additional requirements include mandatory change of passwords:

At first logon with default credentials  
Of admin passwords before deploying

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- b. No general accounts, one account per user
- c. Capability to integrate and use Windows Active Directory for user log on credentials
- d. Include a timed auto log off feature
- e. Use TLS 1.2 encryption or higher
- f. Capability to use blacklisted and whitelisted IPs/MAC addresses to gate access
- g. All devices and software that support HTTP shall allow disabling the HTTP access and require access via HTTPS.
- h. All devices that have web portals for the configuration of IP addresses and other configuration attributes shall have the ability, through commands issued, to disable this service upon completion. A direct connection method with ASCII commands shall enable this service again if changes need to be applied. Loss of power or cycling the device shall not reverse this command. Disabling this web portal eliminates the security risk and the need for updating security patches.
- i. All devices shall support SNMP V3 monitoring of network performance and stack statistics for the purpose of managing denial of service attacks
- j. The Integrated Control Platform shall support the feature to alarm on a predetermined period of time until the default password for each device is changed from the default factory setting.
- k. The Integrated Control Platform shall support encrypted password authentication for all web services whether serving or consuming.

E. Web-based Operator Software

1. General:

- a. Day-to-day operation of the system shall be accessible through a standard web browser interface, allowing technicians and operators to view any part of the system from anywhere on the network.
- b. The system shall be able to be accessed on site via a mobile device environment with, at a minimum, access to overwrite and view system values.

2. Graphic Displays

- a. The browser-based interface must share the same graphical displays as the Administration and Programming Workstations, presenting dynamic data on site layouts, floor plans, and equipment graphics. The browser's graphics shall support commands to change setpoints, enable/disable equipment and start/stop equipment.
- b. Through the browser-based interface, operators must be able to navigate through the entire system, and change the value or status of any point in any controller. Changes are effective immediately to the controller, with a record of the change stored in the system database.

3. Alarm Management

- a. Systems requiring additional client software to be installed on a PC for viewing the webstation from that PC will not be considered.
- b. Through the browser interface, a live alarm viewer identical to the alarm viewer on the Administration and Programming workstation shall be presented, if the user's password allows it. Users must be able to receive alarms, silence alarms, and acknowledge alarms through a browser. If desired, specific operator text must be able to be added to the alarm record before acknowledgement, attachments shall be viewable, and alarm checklists shall be available.

4. Groups and Schedules

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- a. Through the browser interface, operators must be able to view pre-defined groups of points, with their values updated automatically.
  - b. Through the browser interface, operators must be able to change schedules – change start and stop times, add new times to a schedule, and modify calendars.
5. User Accounts and Audit Trail
  - a. The same user accounts shall be used for the browser interface and for the operator workstations. Operators must not be forced to memorize multiple passwords.
  - b. All commands and user activity through the browser interface shall be recorded in the system's activity log, which can be later searched and retrieved by user, date, or both.
- F. User Workstation:
  1. The BAS workstation software shall allow the creation of a custom, browser-style interface linked to the user when logging into any workstation. Additionally, it shall be possible to create customized workspaces that can be assigned to user groups. This interface shall support the creation of "hot-spots" that the user may link to view/edit any object in the system or run any object editor or configuration tool contained in the software. Furthermore, this interface must be able to be configured to become a user's "PC Desktop" – with all the links that a user needs to run other applications. This, along with the Windows user security capabilities, will enable a system administrator to setup workstation accounts that not only limit the capabilities of the user within the BAS software, but may also limit what a user can do on the PC and/or LAN/WAN. This might be used to ensure, for example, that the user of an alarm monitoring workstation is unable to shutdown the active alarm viewer and/or unable to load software onto the PC.
  2. Webstations shall have the capability to automatically re-direct to an HTTPS connection to ensure more secure communications.
  3. Personalized layouts and panels based on username and passwords within workstations shall be extended to webstations to ensure consistent user experiences between the two user interfaces.
  4. Workstations, Servers and NSCs shall have the ability to be located in different time zones, which are then synchronized via the NTP server.
  5. Workstation shall indicate at all times the communication status between it and the server.
- G. Administration and Programming Workstation
  1. The workstation software shall use a familiar Windows Explorer style interface for an operator or programmer to view and/or edit any object (controller, point, alarm, report, schedule, etc.) in the entire system. In addition, this interface shall present a "network map" of all controllers and their associated points, programs, graphics, alarms, and reports in an easy to understand structure. All object names shall be alphanumeric and use Windows long filename conventions.
  2. The configuration interface shall also include support for user defined object types. These object types shall be used as building blocks for the creation of the BAS database. They shall be created from the base object types within the system input, output, string variables, setpoints, etc., alarm algorithms, alarm notification objects, reports, graphics displays, schedules, and programs. Groups of user defined object types shall be able to be set up as a predefined aggregate of subsystems and systems. The configuration interface shall support copying/pasting and exporting/importing portions of the database for additional efficiency. The system shall also maintain a link to all "child" objects created. If a user wishes to make a change to a parent object, the software shall ask the user if he/she wants to update all of the child objects with the change.
- H. Color Graphic Displays

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1. The Administration and Programming Workstation shall allow for the creation of user defined, color graphic displays for the viewing of mechanical and electrical systems, or building schematics. These graphics shall contain point information from the database including any attributes associated with the point (engineering units, etc.). In addition operators shall be able to command equipment or change setpoints from a graphic through the use of the mouse.
2. Requirements of the color graphic subsystem include:
  - a. At a minimum, the user shall have the ability to import .gif, .png, .bmp, .jpeg, .tif, and CAD generated picture files as background displays, and layering shall be possible.
  - b. The system shall support HTML5 enabled graphics.
  - c. It shall be possible for the user to use JavaScript to customize the behavior of each graphic.
  - d. The editor shall use Scalable Vector Graphics (SVG) technology.
  - e. A built-in library of animated objects such as dampers, fans, pumps, buttons, knobs, gauges, and graphs which can be “dropped” on a graphic through the use of a software configuration “wizard”. These objects shall enable operators to interact with the graphic displays in a manner that mimics their mechanical equivalents found on field installed control panels.
  - f. Support for high definition icons shall be included and automatically chosen if viewing on a high definition display such as Retina or 4K displays.
  - g. Using the mouse, operators shall be able to adjust setpoints, start or stop equipment, modify PID loop parameters, or change schedules.
  - h. Status changes or alarm conditions must be able to be highlighted by objects changing screen location, size, color, text, blinking or changing from one display to another.
  - i. Ability to link graphic displays through user defined objects, alarm testing, or the result of a mathematical expression. Operators must be able to change from one graphic to another by selecting an object with a mouse - no menus will be required.
  - j. It shall be possible to create and save graphical components and JavaScript code in reusable and transferrable, customized libraries.
  - k. Graphics should rescale based on whatever monitor or viewing device is being used.
  - l. Be able to create graphics on varying layers that can be moved and repeated.
  - m. Be able to create graphics within varying window panes that can be moved and/or re-referenced. For example, creating the graphical menu within a pane and referencing it on every graphics page, therefore not rebuilding thus allowing for a single spot for updates that get pushed to all the pages that reference it.
  - n. The ability to create re-usable cascading menus.
  - o. The ability to have multiple instances of a graphic and edit one instance to change all.
3. Additionally, the Graphics Editor portion of the Engineering Workstation Software shall provide the following capabilities:
  - a. Create, Modify and save pages.
  - b. Modify an existing symbol and Group and Ungroup symbols.
  - c. Place a symbol on a page and Rotate and Mirror a symbol.
  - d. Place analog dynamic data and changeable setpoints on a page.
  - e. Place binary dynamic data using custom state descriptors on a page.
  - f. Create motion through the use of animated .gif files or JavaScript.
  - g. Place links to other pages, websites, notes, time schedules and various files like .pdf, .doc, .exe etc. on the Workstation using a fixed symbol or flyover on a page.
  - h. Place alarm indicators on a page.
  - i. Change symbol/text/value color as a function of an analog or binary variable.
  - j. All symbols used in the creation of graphic pages shall be saved to a library file for use by the owner.

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I. Automatic monitoring

1. The software shall allow for the automatic collection of data and reporting from any controller or NSC. The frequency of data collection shall be user-configurable.

J. Alarm Management

1. The software shall be capable of accepting alarms directly from NSCs or controllers, or generating alarms based on evaluation of data in controllers and comparing to limits or conditional equations configured through the software. Any alarm (regardless of its origination) will be integrated into the overall alarm management system and will appear in all standard alarm reports, be available for operator acknowledgment, and have the option for displaying graphics, or reports.
2. Alarm management features shall include:
  - a. A minimum of 1000 alarm notification levels at the NSC, workstation, and webstation levels. At the Enterprise level the minimum number of active and viewable alarms shall be 10,000. Each notification level will establish a unique set of parameters for controlling alarm display, distribution, acknowledgment, keyboard annunciation, and record keeping.
  - b. Automatic logging in the database of the alarm message, point name, point value, source device, timestamp of alarm, username and time of acknowledgement, username and time of alarm silence (soft acknowledgement).
  - c. Playing an audible sound on alarm initiation or return to normal.
  - d. Sending an email page to anyone specifically listed on the initial occurrence of an alarm. The ability to utilize email paging of alarms shall be a standard feature of the software using Simple Mail Transfer Protocol (SMTP) with support for secure email using Simple Mail Transfer Protocol Secure (SMTPS). No special software interfaces shall be required and no email client software must be running in order for email to be distributed. The email notification shall be able to be sent to an individual user or a user group.
  - e. Individual alarms shall be able to be re-routed to a user at user-specified times and dates. For example, a critical high temp alarm can be configured to be routed to a Facilities Dept. workstation during normal working hours (7am-4pm, Mon-Fri) and to a Central Alarming workstation at all other times.
  - f. An active alarm viewer shall be included which can be customized for each user or user type to hide or display any alarm attributes.
  - g. The active alarm viewer can be configured such that an operator must type in text in an alarm entry and/or pick from a drop-down list of user actions for certain alarms.
  - h. The active alarm viewer can be configured such that an operator must type in text in an alarm entry and/or pick from a drop-down list of causes for certain alarms. This ensures accountability (audit trail) for the response to critical alarms.
  - i. The active alarm viewer can be configured such that an operator must confirm that all of the steps in a check list have been accomplished prior to acknowledging the alarm.
  - j. The active alarm viewer shall, if filtered, show the quantity of visible and total number of alarms that are not equal to 'normal' and the quantity of disabled and hidden alarms.
  - k. The alarm viewer can be configured to auto hide alarms when triggered.
  - l. An operator shall have the capability to assign an alarm to another user of the system.
  - m. Time schedules shall be able to be used to set control notifications to users.
  - n. An operator shall have the capability to save and apply alarm favorites.
  - o. Alarm notifications must support multiple distribution methods within one notification.

K. Report Generation

1. The Reports Server shall be able to process large amounts of data and produce meaningful reports to facilitate analysis and optimization of each installation.

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2. Reports shall be possible to generate and view from the operator Workstation, and/or Webstation, and/or directly from a reports-only web interface.
3. A library of predefined automatically generated reports that prompt users for input prior to generation shall be available. The properties and configurations made to these reports shall be possible to save as Dashboard reports, so that the configurations are saved for future use.
4. It shall be possible to create reports standard tools, such as Microsoft Report Builder 2.0 or Visual Studio, shall be used for customized reports.
5. Additional reports or sets of reports shall be downloadable, transferrable, and importable
6. All reports shall be able to be set up to automatically run or be generated on demand.
7. Each report shall be capable of being automatically emailed to a recipient in Microsoft Word, Excel, and/or Adobe .pdf format.
8. Reports can be of any length and contain any point attributes from any controller on the network.
9. Image management functionality shall be possible to enable the system administrators to easily upload new logos or images to the system.
10. It shall be possible to run other executable programs whenever a report is initiated.
11. Report Generator activity can be tied to the alarm management system, so that any of the configured reports can be displayed in response to an alarm condition.
12. Minimum supplied reports shall include:
  - a. Activities Per Server Report
  - b. Activities Per User Report
  - c. Alarm Amount by Category Report
  - d. Alarm Amount by Type Report
  - e. Alarms Per Sever Report
  - f. Current Alarm Report
  - g. Most Active Alarm Report
  - h. System Errors Per Server Report
  - i. Top Activities Report
  - j. Top Alarms Report
  - k. Top System Errors Report
  - l. Trend Log Comparison Report
  - m. User Logins Report
  - n. Users and Groups Reports
13. Minimum Energy Reports shall include:
  - a. Energy Monitoring Calendar Consumption Report: Shall provide an interactive report that shows the energy usage on one or multiple selected days.
  - b. Energy Monitoring Consumption Breakdown Report: Shall provide a report on energy consumption broken down using sub-metering.
  - c. Energy Monitoring Consumption Report: Shall show the energy consumption against a specified target value.

L. Scheduling

1. From the workstation or webstation, it shall be possible to configure and download schedules for any of the controllers on the network.
2. Time of day schedules shall be in a calendar style and viewable in both a graphical and tabular view.
3. Schedules shall be programmable for a minimum of one year in advance.
4. To change the schedule for a particular day, a user shall simply select the day and make the desired modifications.

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5. Additionally, from the operator webstations, each schedule will appear on the screen viewable as the entire year, monthly, week and day. A simple mouse click shall allow switching between views. It shall also be possible to scroll from one month to the next and view or alter any of the schedule times.
6. Schedules will be assigned to specific controllers and stored in their local RAM memory. Any changes made at the workstation will be automatically updated to the corresponding schedule in the controller.
7. It shall be possible to assign a lead schedule such that shadow/local schedules are updated based upon changes in the Lead.
8. It shall be possible to assign a list(s) of exception event days, dates, date ranges to a schedule.
9. It shall be possible to view combined views showing the calendar and all prioritized exemptions on one screen.
10. It should accommodate a minimum of 16 priority levels.
11. Values should be able to be controlled directly from a schedule, without the need for special program logic.

M. Programmer's Environment

1. Programming shall allow both graphical block format and line-programming format. For both languages, the programmer will be able to configure application software for custom program development, and write global control programs. Both languages will have debugging capabilities in their editors.
2. Programming of the NSC and SDCUs shall be available offline from system prior to deployment into the field. All engineering tasks shall be possible, except, of course, the viewing of live tasks or values.
3. It shall be possible to save custom programs as libraries for reuse throughout the system. A wizard tool shall be available for loading programs from a library file in the program editor.
4. It shall be possible to view graphical programming live and real-time from the Workstation.
5. The system shall be capable of creating 'binding templates' allowing the user to bind multiple points to multiple objects all at once.
6. Key terms should automatically complete when typing (IntelliType).
7. Applications should be able to be assigned different priorities and cycle times for a prioritized execution of different functions.
8. The system shall be able to create macro objects that allow common objects such as power meters, VFD drives, etc. to be integrated into the system with simple import actions without the need of complicated programming or configuration setups.
9. The workstation software shall have an application to save and restore programming and graphic files. The application must also be able to save/reload individual programs in the controller allowing modification of control programs without disturbing any other online functions.

N. Audit Trail

1. The workstation software shall automatically log and timestamp every operation that a user performs at a workstation, from logging on and off a workstation to changing a point value, modifying a program, enabling/disabling an object, viewing a graphic display, running a report, modifying a schedule, etc.
2. It shall be possible to view a history of alarms, user actions, and commands for any system object individually or at least the last 5000 records of all events for the entire system from Workstation.
3. The Enterprise server shall be able to store up to 5 million events.
4. The event view shall support viewing of up to 100,000 events.
5. It shall be possible to save custom filtered views of event information that are viewable and configurable in Workstation.
6. It shall be capable to search and view all forced values within the system.

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2.3 Network Server Controllers (NSCs)

- A. Network Router Controllers shall combine both network routing functions, control functions, and server functions into a single unit.
- B. The NSC shall be classified as a “native” BACnet device, supporting the BACnet Network Server Controller (B-BC) profile. Controllers that support a lesser profile such as B-SA are not acceptable. NSCs shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Network Server Controllers (B-BC).
- C. The NSC shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NRS.
- D. The NSCs shall be capable of whitelisting IPs to restrict access to a pre-defined list of hosts or devices.
- E. Whitelisting of file extensions for documents shall be capable.
- F. Encrypted and authenticated communication shall be configurable for non-open protocol communications using TLS 1.2
- G. The NSCs shall support Simple Network Management Protocol version 3 (SNMPv3) for monitoring of the NSCs using a Network Management Tool.
- H. The NSCs shall support remote system logging for used by System Information and Event Monitoring (SIEM) software.
- I. They shall also be responsible for monitoring and controlling their own HVAC equipment such as an AHU, chiller system or boiler system.
- J. They shall also contain graphics, trends, trend charts, alarm views, and other similar presentation objects that can be served to workstations or web-based interfaces. A sufficient number of NSCs shall be supplied to fully meet the requirements of this specification and the attached point list.
- K. Each NSC shall be capable of executing application control programs to provide:
  - 1. Calendar functions
  - 2. Scheduling
  - 3. Trending
  - 4. Alarm monitoring and routing
  - 5. Time synchronization by means of an Internet site including automatic synchronization
  - 6. Native integration of Modbus controller data or BACnet controller data
- L. Hardware Specifications
  - 1. Memory:
    - a. The operating system of the controller, application programs, and all other portions of the configuration database, shall be stored in non-volatile, FLASH memory. Servers/Controllers shall contain enough memory for the current application, plus required history logging, plus a minimum of 20% additional free memory.
  - 2. Each NSC shall provide the following on-board hardware for communication:
    - a. Two 10/100b Ethernet for communication to Workstations, other NRCs, IP field bus controllers, other SDCUs, and onto the internet.
      - 1) The two Ethernet ports shall support active switch and BACnet/IP communication protocols.
      - 2) Support IPv4 addressing
      - 3) Ethernet port 1 shall support static or DHCP client configuration for communication to Workstation or other NSCs
      - 4) Ethernet port 2 shall support switch mode or DHCP server to set addressing of DHCP client devices



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- 5) It shall be possible to disable Ethernet port 2
- 6) In DHCP server mode, the Ethernet port 2 shall support 50 BACnet/IP field controllers in daisy chain configuration directly from the port
- 7) Each NSC shall be able to support a total of 250 IP SDCUs in daisy chain configuration (5 sub networks via switch)
- 8) If using RSTP (Rapid Spanning Tree Protocol) with a managed switch (with IEEE 802.1W or IEEE 802.1Q-2014 support), Ethernet port 2 shall support up to 39 devices
- 9) Each NSC shall be able to support a total of 234 IP SDCUs in RSTP configuration (6 sub networks via managed switch)
- 10) Where a switch is needed, use Planet IGS-801M, or other equal and approved equivalent.

- b. Two RS-485 ports for communication to BACnet MSTP bus or serial Modbus (software configurable)
- c. One device USB port
- d. One host USB port

M. Modular Expandability:

1. The system shall employ a modular I/O design to allow expansion. Input and output capacity is to be provided through plug-in modules of various types. It shall be possible to combine I/O modules as desired to meet the I/O requirements for individual control applications.
2. One shall be able to "hot-change" (hot-swap) the I/O modules preserving the system on-line without any intervention on the software; addressing and configuration shall be automatic.
3. If for any reason the backplane of the modular I/O system were to fail, I/O module addresses will be protected.

N. Hardware Override Switches:

1. All digital outputs shall, optionally, include three position manual override switches to allow selection of the ON, OFF, or AUTO output state. These switches shall be built into the unit and shall provide feedback to the controller so that the position of the override switch can be obtained through software. In addition each analog output shall be equipped with an override potentiometer to allow manual adjustment of the analog output signal over its full range, when the 3 position manual override switch is placed in the ON position.

O. Universal Input Temperatures

1. All universal inputs directly connected to the NSC via modular expansion shall be capable of using the following thermistors for use in the system without any external converters needed.
  - a. 10 kohm Type I, II, III, IV or V
  - b. 1.8 kohm (Xenta), 1 kOhm (Balco), 20 kOhm (Honeywell) and 2.2 kOhm (JCI)

P. Local Status Indicator Lamps:

1. The NSC shall provide as a minimum LED indication of CPU status, Ethernet LAN status, and field bus status. For each input or output, provide LED indication of the value of the point (On/Off). The LED indication shall support software configuration to set whether the illumination of the LED corresponds to On or Off or whether the color when illuminated is Red or Green.

Q. Real Time Clock (RTC):

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1. Each NSC shall include a real time clock, accurate to 10 seconds per day. The RTC shall provide the following: time of day, day, month, year, and day of week. Each NSC will allow for its own UTC offset, depending upon the time zone. When the time zone is set, the NSC will also store the appropriate times for daylight savings time.
2. The RTC date and time shall also be accurate, up to 30 days, when the NSC is powerless.
3. No batteries may be used to for the backup of the RTC.

R. Power Supply:

1. The 24 VDC power supply for the NSCs shall provide 30 watts of available power for the NSC and any associated IO modules. The system shall support the use of more than one power supply if heavily power consuming modules are required.
2. The power supply, NSC, and I/O modules shall connect power wise and communication wise via the separate terminal base allowing for ease of replacement and no separate or loose wiring.

S. Automatic Restart After Power Failure:

1. Upon restoration of power after an outage, the NSC shall automatically and without human intervention update all monitored functions, resume operation based on current, synchronize time and status, and implement special start-up strategies as required.
2. During a power failure, the NSC shall retain all programs, configuration data, historical data, and all other data that is configured to be retained. There shall be no time restriction for this retention and it must not use batteries to achieve it.

T. Software Specifications

1. The operating system of the controller, application programs, and all other portions of the configuration database such as graphics, trends, alarms, views, etc., shall be stored in non-volatile, FLASH memory. There will be no restrictions placed on the type of application programs in the system. Each NSC shall be capable of parallel processing, executing all control programs simultaneously. Any program may affect the operation of any other program. Each program shall have the full access of all I/O facilities of the processor. This execution of control function shall not be interrupted due to normal user communications including interrogation, program entry, printout of the program for storage, etc.
2. Each NSC shall have an available capacity of 4 GB of memory. This shall represent 2 GB for application and historical data and 2 GB dedicated for backup storage.

U. User Programming Language:

1. The application software shall be user programmable. This includes all strategies, sequences of operation, control algorithms, parameters, and setpoints. The source program shall be either a script-based structured text or graphical function block based and fully programmable by the user. The language shall be structured to allow for the configuration of control programs, schedules, alarms, reports, telecommunications, local displays, mathematical calculations, and histories. Users shall be able to place comments anywhere in the body of either script or function block programs.
2. Network Server Controllers that use a “canned” program method will not be accepted.

V. Control Software:

1. The NSC shall have the ability to perform the following pre-tested control algorithms:
  - a. Proportional, Integral plus Derivative Control (PID)

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- b. Two Position Control
- c. Digital Filter
- d. Ratio Calculator
- e. Equipment Cycling Protection

W. Mathematical Functions:

1. Each controller shall be capable of performing basic mathematical functions (+, -, \*, /), squares, square roots, exponential, logarithms, Boolean logic statements, or combinations of both. The controllers shall be capable of performing complex logical statements including operators such as >, <, =, and, or, exclusive or, etc. These must be able to be used in the same equations with the mathematical operators and nested up to five parentheses deep.

X. NSCs shall have the ability to perform any or all of the following energy management routines:

1. Time of Day and Calendar Scheduling with Holiday and Temporary Overrides
2. Optimal Start & Optimal Stop with Night Setback Control
3. Enthalpy Switchover (Economizer)
4. Peak Demand Limiting
5. Temperature Compensated Duty Cycling
6. Supply Fan demand based pressure reset
7. Heating/Cooling Interlock with Hot/Cold Deck Reset
8. Hot Water, Chilled Water and Condenser Reset
9. Chiller Sequencing and Chiller Plant Optimization

Y. History Logging:

1. Each NSC controller shall be capable of LOCALLY logging any input, output, calculated value or other system variable either over user defined time intervals ranging from 1 second to 1440 minutes or based upon a user configurable change of value. A minimum of 1000 logs, with a minimum of 100,000 records, shall be stored. Each log can record either the instantaneous, average, minimum or maximum value of the point. Logged data shall be downloadable to a higher level NSC long term archiving based upon user-defined time intervals, or manual command.
2. For extended trend logging a minimum of 1500 trends shall be capable, with a minimum number of 600,000 records within.
3. Management of a power meter replacement to ensure meter log data is accurate shall be possible in the NSC.
4. Every hardware input and output point, hosted within the NSC and attached I/O modules, shall be trended automatically without the requirement for manual creation, and each of these logs shall log values based upon a change of value and store at least 500 trend samples before replacing the oldest sample with new data.
5. The presentation of logged data shall be built into the server capabilities of the NSC. Presentation can be in time stamped list formats or in a chart format with fully configurable pen colors, weights, scales and time spans.
6. Tooltips shall be present, magnetic, and visible based on users preference.
7. Comments shall be visible whenever viewing the trend log list.
8. System shall give indication of memory usage and be able to alert the user if too many logs are allocated.

Z. Alarm Management:

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1. For each system point, alarms can be created based on high/low limits or in comparison to other point values. All alarms will be tested each scan of the NSC and can result in the display of one or more alarm messages or reports.
2. There is no limit to the number of alarms that can be created for any point
3. Alarms can be configured to be generated based upon a single system condition or multiple system conditions.
4. Alarms will be generated based on an evaluation of the alarm conditions and can be presented to the user in a fully configurable order, by priority, by time, by category, etc. These configurable alarm views will be presented to a user upon logging into the system regardless of whether the log in takes place at a WorkStation or a Webstation.
5. The alarm management system shall support the ability to create and select cause and action notes to be selected and associated with an alarm event. Checklists shall also be possible in order to present to an operator a suggested mode of troubleshooting. When acknowledging an alarm, it shall be possible to assign it to a user of the system such that the user is notified of the assignment and is made responsible for the alarm resolution.
6. Alarms must be capable of being routed to any BACnet workstation that conforms to the B-OWS device profile and uses the BACnet/IP protocol.

AA. Embedded Web Server

1. Each NSC must have the ability to serve out web pages containing the same information that is available from the WorkStation. The development of the screens to accomplish shall not require any additional engineering labor over that required to show them at the WorkStation itself.
2. The NSC shall be configurable to logging all Embedded Web Server access attempts
3. The NSC shall have the option to redirect HTTP based Embedded Web Server connections to secure, HTTPS connections.
4. The NSC shall authenticate and authorize all users connecting to the Embedded Web Server
5. The NSC shall provide to ability to configure an automatic logoff for Embedded Web Server users that have not had any activity for an adjustable time period.

2.4 BACnet IP Fieldbus Controllers (SDCUs)

A. Controllers – BACnet/IP Protocol

1. All BACnet/IP Fieldbus controllers shall be BACnet Testing Laboratory listed (v12 or later) as specified BACnet Advanced Application Controller (B-AAC)
2. All BACnet/IP Fieldbus controllers shall use the following communication specifications and achieve performance as specified herein:
  - a. All controllers shall be able to communicate peer-to-peer without the need for a NSC
  - b. Any BACnet/IP Fieldbus controllers on the Ethernet Data Link/Physical layer shall be able to act as a Master to allow for the exchange and sharing of data variables and messages with any other controller connected on the same communication cabling. Slave controllers are not acceptable.

B. The BACnet/IP Fieldbus controllers shall be equipped with 2x 10/100bT Ethernet communication ports with active switch and will support BACnet/IP communication protocols with the following configurations:

1. Supporting IPv4 addressing
2. Supporting Static IP setting, DHCP client and Auto-IP address acquisition
3. It shall be possible to disable Ethernet port 2

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C. Topologies

1. BACnet/IP Fieldbus controllers shall support daisy chain topology of up to 50 controllers. In case of any disruption to the communication, a system alarm shall notify the NSC/BMS of the point disruption has occurred.
2. BACnet/IP Fieldbus Controllers shall support RSTP loop whereby up to 39 controllers are supported.
  - a. In case of any disruption there shall be no communication interruption
  - b. In case of any disruption there shall be system alarms that will inform the operator of the disruption

D. Performance

1. Each BACnet/IP Fieldbus Controllers shall have a 32-bit microprocessor operating at 500 MHz and support a BACnet protocol stack in accordance with the ANSI/ASHRAE Standard 135-2008 and the BACnet Device Profile supported.
2. They shall be multi-tasking, real-time digital control processors consisting of communication controllers, controls processing, power supplies with built-in inputs and outputs.

E. Programmability

1. The BACnet/IP Fieldbus controllers shall support both script programming language and graphical that will be consistent with the NSC.
2. The control program will reside within the same enclosure as the input/output circuitry, that reads inputs and controls outputs
3. All control sequences programmed into the BACnet/IP Fieldbus Controllers shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.
4. BACnet/IP Fieldbus controllers shall communicate with the Network Server Controller (NSC) via a BACnet/IP connection at a baud rate of not less than 100 Mbps
5. BACnet/IP Fieldbus controllers shall support a dedicated communications port for connecting and supplying power to a matching room temperature and/or humidity sensor and/or CO2 and/or presence detector that does not utilize any of the I/O points of the controller.
6. BACnet/IP Fieldbus controllers (Excluding VAV) shall support an add-on display to supply and provide access in real-time for monitoring inputs and overriding of outputs
7. The override functionality must be supported by a dedicated processor to assure reliable operation (overriding of output)
8. Each BACnet/IP Fieldbus controller shall have sufficient memory, to support its own operating system and databases, including:
  - a. Control processes
  - b. Energy management applications
  - c. Alarm management
  - d. Historical/trend data
  - e. Maintenance support applications
  - f. Custom processes
  - g. Manal override monitoring
9. Each BACnet/IP Fieldbus controller shall support local trend data up to 2x the built-in I/O and at a minimum be capable of holding 5 days @ 15 min intervals locally.
10. The BACnet/IP Fieldbus controller analog or universal input shall use a 16 bit A/D converter.
11. The BACnet/IP Fieldbus controller analog or universal output shall use a 10 bit D/A converter.
12. Built-in I/O: each BACnet/IP Fieldbus controllers shall support:

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- a. At minimum 8 and up to 20 configurable IO channels to monitor and to control the following types of inputs and outputs without the addition of equipment inside or outside the DDC Controller cabinet.
  - 1) Universal Inputs – the following thermistors for use in the system without any external converters needed.
    - a) 10 kohm Type I, II, III, IV or V
    - b) 1.8 kohm (Xenta), 1 kOhm (Balco), 20 kOhm (Honeywell) and 2.2 kOhm (JCI)
  - 2) Analog inputs
    - a) Current Input - 0-20 mA
    - b) Voltage Input 0-10 Vdc
  - 3) Digital inputs from dry contact closure, pulse accumulators, voltage sensing.
  - 4) Digital outputs
  - 5) Analog outputs of 4-20 mA and/or 0-10 Vdc
- 13. Real Time Clock (RTC):
  - a. Each BACnet/IP Fieldbus controller shall include a real time clock, accurate to +/-1 minute per month. The RTC shall provide the following: time of day, day, month, year, and day of week.
  - b. The RTC date and time shall also be accurate, up to 7 days, when the BACnet/IP Fieldbus controller is powerless.
  - c. No batteries may be used to for the backup of the RTC.
- 14. The BACnet/IP Fieldbus controller for Variable Air Volume (VAV) applications
  - a. The BACnet/IP Fieldbus controller for VAV applications shall include a built-in 'flow thru' differential pressure transducer
  - b. The VAV differential pressure transducer shall have a measurement range of 0 to 1 in. W.C. and measurement accuracy of  $\pm 5\%$  at 0.001 to 1 in. W.C. and a minimum resolution of 0.001 in. W.C., insuring primary air flow conditions shall be controlled and maintained to within  $\pm 5\%$  of setpoint at the specified minimum and maximum air flow parameters
  - c. The BACnet/IP FieldBus controller for VAV applications shall support a dedicated commissioning tool for air flow balancing
  - d. The BACnet/IP Fieldbus controller for VAV applications shall require no programing for air balancing algorithm
  - e. All balancing parameters shall be synchronized in NSC
- 15. Each BACnet/IP Fieldbus controller shall have a minimum of 10% spare capacity for each point type represented on the controller for future point connection
- 16. Power Requirements.: 24VDC (21 to 33 VDC) and 24 VAC +/-20% with local transformer power
- F. Commissioning Tool - The BACnet/IP Fieldbus controller shall be supported via a dedicate mobile based commissioning tool for configuration, programming, air balancing and I/O checkout
  - 1. The Commissioning Tool shall be supported across: iOS, Android and Windows 10 platforms
  - 2. The Commissioning Tool shall be available for download on App Store, Google Store and Windows Store

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3. Commissioning Tool Interface to BACnet/IP Fieldbus controllers shall be via a Bluetooth adapter interface through the Intelligent Space Sensor or via a Wi-Fi access point on the LAN
4. Functionality
  - a. Device Configuration – the Commissioning Tool shall be able to set or edit all Network configurations associated with the BACnet/IP Fieldbus controller
  - b. Programming – The Commissioning Tool shall be able to load offline engineered applications directly in to the controller directly
  - c. Air Balancing
    - 1) The Commissioning Tool shall allow the air balancer to manually control the action of the actuator including the following function: open VAV damper, close VAV damper, open all VAV dampers, and close all VAV dampers.
    - 2) The Commissioning Tool shall be able to generate Air Balancing report
  - d. IO Checkout
    - 1) The Commissioning Tool shall be able to support overriding of the outputs and reading value of inputs live
    - 2) The Commissioning Tool shall be able to support generation of I/O checkout report
  - e. There shall be no limit to the number of Commissioning Tools that can be used on a network segment, however, one connection per controller is recommended
- G. Intelligent Space Sensors - The BACnet/IP Fieldbus controller shall support a dedicated RJ45 communication port to communicate and power up to 4 intelligent wall mount sensors without the use of on board inputs or outputs
  1. The Intelligent Space Sensor shall communicate with the BACnet/IP Fieldbus controller through the sensor port and via category 5 or category 6 cable
  2. The Intelligent Space Sensor shall provide 2 RJ45 communication ports that will allow communication with parent BACnet/IP Field controller upstream and additional Intelligent Space Sensors downstream
  3. The Intelligent Space Sensor shall provide ambient space condition sensing without the use of hardware I/O
  4. Each Intelligent Space Sensor shall provide a color touch display with a Minimum 61 mm (2.4”) by 61 mm (2.4”) display that is backlit
  5. The Intelligent Space Sensor shall be capable of displaying measured space temperature from 0 to 50 °C (32 to 122 °F) with accuracy of  $\pm 0.2$  °C ( $\pm 0.4$  °F) selectable for 0.1 or 1 degree display resolution of °F or °C. Sensing Element: 10k Type 3 Thermistor, Accuracy of  $\pm 0.2$  °C ( $\pm 0.4$  °F)
  6. The Intelligent Space Sensor shall have the option for humidity sensor support sensing humidity from 0 % RH to 100 % RH Digital humidity indication (selectable for 0.1 or 1% RH with selectable display resolution of 0.1 or 1 % RH, Accuracy:  $\pm 2$  % RH)
- H. The Intelligent Space Sensor shall have the option for support of CO2 sensor with display resolution with 0 to 2000 ppm resolution
  1. Accuracy:  $\pm 30$  ppm  $\pm 2\%$  of measured value
  2. Operating elevation: 0 to 16,000 ft.
  3. Temperature dependence: 0.11% FS per °F
  4. Stability:  $< 2\%$  of FS over life of sensor (15 years)
  5. Sensing method: Non-dispersive infrared (NDIR), diffusion sampling

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- I. The Intelligent Space Sensor shall have the option for motion sensor
- J. Display options: The Intelligent Space Sensor shall be capable of displaying the following elements:

- 1. Space temperature
- 2. Cooling space temperature set point
- 3. Heating space temperature set point
- 4. Current heating or cooling mode
- 5. Current occupancy mode
- 6. Fan speed
- 7. Current time

2.5 BACnet MSTP Fieldbus controllers (SDCUs)

A. Field Bus Wiring and Termination

- 1. The wiring of MSTP controller shall use a bus or daisy chain concept with no tees, stubs.
- 2. Each field bus shall have a termination resistor at both ends of each segment.

B. Field Bus Devices

- 1. General Requirements
  - a. Devices shall have a light indicating that they are powered.
  - b. Application programs shall be stored in a manner such that a loss of power does not result in a loss of the application program or configuration parameter settings. (Battery backup, flash memory, etc.)

C. Advance Application Controllers (B-AAC)

- 1. The key characteristics of a B-AAC are:
  - a. They have physical input and output circuits for the connection of analog input devices, binary input devices, pulse input devices, analog output devices, and binary output devices. The number and type of input and output devices supported will vary by model.
  - b. They may or may not provide support for additional input and output devices beyond the number of circuits that are provided on the basic circuit board. Support for additional I/O shall be provided by additional circuit boards that physically connect to the basic controller.
  - c. The application to be executed by a B-AAC is created by an application engineer using the vendor's application programming tool.
  - d. If local time schedules are embedded, the B-AAC shall support the editing of time schedule entries from any BACnet OWS that supports the BACnet service for writing of time schedule parameters.
  - e. If local trend logging is embedded, the B-AAC shall support the exporting of trend log data to any BACnet OWS that supports the read range BACnet service for trending.
  - f. If local alarm message initiation is embedded, the B-AAC shall:
    - 1) Deliver alarm messages to any BACnet OWS that supports the BACnet service for receiving alarm messages and is configured to be a recipient off the alarm message.
    - 2) Support alarm acknowledgement from any BACnet OWS that supports the BACnet service for executing alarm/event acknowledgement,



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- g. Shall support the reading of analog and binary data from any BACnet OWS or Building Controller that supports the BACnet service for the reading of data.
  - h. Shall support the control of the out of service property and assignment of value or state to analog and binary objects from any BACnet OWS that supports writing to the out of service property and the value property of analog and binary objects.
  - i. Shall support the receipt and response to Time Synchronization commands from a BACnet Building Controller.
  - j. Shall support the "Who is" and "I am." BACnet services.
  - k. Shall support the "Who has" and "I have." BACnet services.
- 2. Analog Input Circuits
  - a. The resolution of the A/D chip shall not be greater than 0.01 Volts per increment. For an A/D converter that has a measurement range of 0 to 10 VDC and is 10 bit, the resolution is 10/1024 or 0.00976 Volts per increment.
  - b. For non-flow sensors, the control logic shall provide support for the use of a calibration offset such that the raw measured value is added to the (+/-) offset to create a calibration value to be used by the control logic and reported to the Operator Workstation (OWS).
  - c. For flow sensors, the control logic shall provide support for the use of an adjustable gain and an adjustable offset such that a two point calibration concept can be executed (both a low range value and a high range value are adjusted to match values determined by a calibration instrument).
  - d. For non-linear sensors such as thermistors and flow sensors the B-AAC shall provide software support for the linearization of the input signal.
- 3. Binary Input Circuits
  - a. Dry contact sensors shall wire to the controller with two wires.
  - b. An external power supply in the sensor circuit shall not be required.
- 4. Pulse Input Circuits
  - a. Pulse input sensors shall wire to the controller with two wires.
  - b. An external power supply in the sensor circuit shall not be required.
  - c. The pulse input circuit shall be able to process up to 20 pulses per second.
- 5. True Analog Output Circuits
  - a. The logical commands shall be processed by a digital to analog (D/A) converter chip. The 0% to 100% control signal shall be scalable to the full output range which shall be either 0 to 10 VDC, 4 to 20 milliamps or 0 to 20 milliamps or to ranges within the full output range (Example: 0 to 100% creates 3 to 6 VDC where the full output range is 0 to 10 VDC).
  - b. The resolution of the D/A chip shall not be greater than 0.04 Volts per increment or 0.08 milliamps per increment.
- 6. Binary Output Circuits
  - a. Single pole, single throw or single pole, double throw relays with support for up to 230 VAC and a maximum current of 2 amps.
  - b. Voltage sourcing or externally powered triacs with support for up to 30 VAC and 0.5 amps at 24 VAC.
- 7. Program Execution

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- a. Process control loops shall operate in parallel and not in sequence unless specifically required to operate in sequence by the sequence of control.
- b. The sample rate for a process control loop shall be adjustable and shall support a minimum sample rate of 1 second.
- c. The sample rate for process variables shall be adjustable and shall support a minimum sample rate of 1 second.
- d. The sample rate for algorithm updates shall be adjustable and shall support a minimum sample rate of 1 second.
- e. The application shall have the ability to determine if a power cycle to the controller has occurred and the application programmer shall be able to use the indication of a power cycle to modify the sequence of controller immediately following a power cycle.

## 2.6 Control dampers

- A. Unless otherwise specified elsewhere, shall be as below or as scheduled on drawings.
  1. Outdoor and/or return air mixing dampers and face and bypass (F&BP) dampers shall be parallel blade, arranged to direct airstreams toward each other.
  2. Other modulating dampers shall be the opposed blade type.
  3. Two position shutoff dampers may be parallel or opposed blade type with blade and side seals.
- B. Damper frames shall be 13 gauge galvanized steel channel or 1/8 inch extruded aluminum with reinforced corner bracing.
- C. Damper blades shall not exceed 20 centimeters (eight inches) in width or 125 centimeters (48 inches) in length. Blades are to be suitable for medium velocity performance (2000 FPM). Blades shall be not less than 16 gauge.
- D. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze or better.
- E. All blade edges and top and bottom of the frame shall be provided with replaceable butyl rubber or neoprene seals. Side seals shall be spring-loaded stainless steel. The blade seals shall provide for a maximum leakage rate of 10 CFM per square foot at four inches w.g. differential pressure. Provide air foil blades suitable for a wide-open face velocity of 1500 FPM.
- F. Individual damper sections shall not be larger than 48 inches by 60 inches. Provide a minimum of one damper actuator per section.
- G. Modulating dampers shall provide a linear flow characteristic where possible.
- H. Dampers shall have exposed linkages.
- I. Approved manufacturer: Ruskin or approved equal.

## 2.7 Electric Actuators for Control Dampers or Control Valves

- A. The actuator shall have mechanical or electronic stall protection to prevent damage to the actuator throughout the rotation of the actuator.
- B. Where shown, for power failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing. Alternatively, an uninterruptible power supply (UPS) may be provided.
- C. Proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range.
- D. All 24 VAC/VDC actuators shall operate on Class 2 wiring.
- E. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 7 N.m (60 inches-pound) torque capacity shall have a manual crank for this purpose.
- F. Approved manufacturer: Belimo

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2.8 Temperature Sensors

- A. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
- B. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of five feet in length per ten square feet of duct cross section.
- C. Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed. The well must withstand the flow velocities in the pipe.
- D. Space sensors shall be equipped with setpoint adjustment, override switch, LCD display, and/or communication port as shown.
- E. Provide matched temperature sensors for differential temperature measurement.
- F. Low Limit Thermostats: Low limit air stream thermostats shall be UL listed, vapor pressure type, with an element of 20 feet minimum length. Element shall respond to the lowest temperature sensed by any one foot section. The low limit thermostat shall be manual reset only.

2.9 Humidity Sensors

- A. Duct and room sensors shall have a sensing range of 20 percent to 80 percent.
- B. Duct sensors shall be provided with a sampling chamber.
- C. Outdoor air humidity sensors shall have a sensing range of 20 percent to 95 percent relative humidity. They shall be suitable for ambient conditions of -40 degrees F to 170 degrees F.
- D. Humidity sensor's drift shall not exceed one percent of full scale per year.

2.10 Relays

- A. Control relays shall be UL listed plug-in type with dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.

2.11 Local Control Enclosures

- A. All indoor control cabinets shall be fully enclosed NEMA 1 construction with (hinged door) key lock latch and removable sub panels. A single key shall be common to all field panels and sub panels.
- B. Interconnections between internal and face mounted devices shall be pre-wired with color coded stranded conductors neatly installed in plastic troughs and/or tie wrapped. Terminals for field connections shall be UL listed for 600 volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
- C. Provide on/off circuit breaker with proper over current rating for control power sources to each local panel.
- D. All outside mounted enclosures shall meet the NEMA-4 rating.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that power supply is available to control units.

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.

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- B. Connect and configure equipment and software to achieve sequence of operation specified.
- C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.
  - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- D. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- E. Install labels and nameplates to identify control components according to Division 23 Section "Mechanical Identification."
- F. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."
- G. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.
- H. Install electronic and fiber-optic cables according to Division 26 Section "Voice and Data Communication Cabling."
- I. Install raceways, boxes, and cabinets according to Division 16 Section "Raceways and Boxes."
- J. Install building wire and cable according to Division 16 Section "Conductors and Cables."
- K. Install signal and communication cable according to Division 16 Section "Voice and Data Communication Cabling."
  - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
  - 2. Install exposed cable in raceway.
  - 3. Install concealed cable in raceway.
  - 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.
- L. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- M. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

### 3.3 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 each point through its full operating range to verify that safety and operating control set points are as required.
  - 4. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
  - 5. Test each system for compliance with sequence of operation.
  - 6. Test software and hardware interlocks.

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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 flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
5. Check temperature instruments and material and length of sensing elements.
6. Check control valves. Verify that they are in correct direction.
7. 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.

3.4 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 milliamper 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:

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- 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 with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
  9. Provide diagnostic and test instruments for calibration and adjustment of system.
  10. 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.
- 3.5 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 1 Section "Demonstration and Training." Training shall be set for a period of (2) 4 hour sessions with owner designated personnel.

**END OF SECTION**

SECTION 232113 – 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, and specialties for the following:
  - 1. Condensate-drain piping.

1.3 DEFINITIONS

- A. PTFE: Polytetrafluoroethylene.
- B. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
- C. RTRP: Reinforced thermosetting resin (fiberglass) pipe.
- D. O-Let: Either Weldolets and Threadolets.

1.4 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
  - 1. Condensate-Drain Piping: 150 deg F.
  - 2. 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.
- B. Shop Drawings: Detail, at 1/4 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.

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- E. Field quality-control test reports.
- F. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

#### 1.6 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. 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.
- C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves 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.

### PART 2 - PRODUCTS

#### 2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. DWV Copper Tubing: ASTM B 306, Type DWV.
- C. Wrought-Copper Fittings: ASME B16.22.
- D. Wrought-Copper Unions: ASME B16.22.

#### 2.2 PLASTIC PIPE AND FITTINGS

- A. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.
- B. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

#### 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 maximum thickness unless thickness or specific material is indicated.



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- 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, carbon steel, unless otherwise indicated.
- C. Solvent Cements for Joining Plastic Piping:
  - 1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
    - a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    - b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    - c. Solvent cement and adhesive primer 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."
- D. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

### PART 3 - EXECUTION

#### 3.1 PIPING APPLICATIONS

- A. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

#### 3.2 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 condensate piping at minimum one-eighth inch vertical in 12" horizontal slope.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.

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- H. Install piping to allow application of insulation.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- K. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- L. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- M. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

### 3.3 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 long.
  - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
  - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet 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.
  - 6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- C. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- D. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

### 3.4 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.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

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- E. Plastic Piping Solvent-Cemented 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. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  - 3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
  - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.

### 3.5 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

### 3.6 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.

**END OF SECTION**

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SECTION 232300 – 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-410A, R-454B & R-32:
  - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
  - 2. Suction Lines for Heat-Pump Applications: 535 psig.
  - 3. Hot-Gas and Liquid Lines: 535 psig.

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. Filter dryers.
  - 4. Strainers.
  - 5. 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: 1/4 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.

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- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

#### 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. These items are specified in Division 07 Section "Roof Accessories."

### PART 2 - PRODUCTS

#### 2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K or L, ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. 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 misalignment in minimum 7-inch- long assembly.
  - 4. Pressure Rating: Factory test at minimum 500 psig.
  - 5. Maximum Operating Temperature: 250 deg F.

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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.
7. Maximum Operating Temperature: 275 deg F.

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.
8. Maximum Operating Temperature: 275 deg F.

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.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

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.

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 conduit adapter, and 24-V ac coil.
6. Working Pressure Rating: 400 psig.

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7. Maximum Operating Temperature: 240 deg F.
  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.
  6. Maximum Operating Temperature: 240 deg F.
- 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.
  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.
- H. 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.
  5. Maximum Operating Temperature: 275 deg F.
- I. 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.
  6. Maximum Operating Temperature: 275 deg F.
- J. 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.
  7. Maximum Operating Temperature: 240 deg F.

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K. 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.
4. End Connections: Socket.
5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
6. Maximum Pressure Loss: 2 psig.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

L. 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.
7. Maximum Operating Temperature: 275 deg F.

M. 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.
4. Maximum Operating Temperature: 275 deg F.

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-410A: Pentafluoroethane/Difluoromethane.
- D. ASHRAE 34, R-454B: Hydrofluorocarbon/hydrofluoroolefin
- E. ASHRAE 34, R-32: Difluoromethane



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PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction and Liquid line sets for single ductless split systems: PDM Gelcopper, pre-insulated Type ACR piping with polyethylene closed cell insulation. Insulation thickness: 3/4" and wrought-copper fittings with brazed joints.
- B. Suction, Hot-Gas and Liquid Lines: Copper, Type L, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.
- C. Safety-Relief-Valve Discharge Piping:
  - 1. Copper, Type ACR, annealed- or 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.

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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.

### 3.3 PIPING INSTALLATION

- A. 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. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection.
- L. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- M. 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.

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- N. When brazing or soldering, 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.
- O. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- P. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."
- Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- R. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- S. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.
- T. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

### 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.

### 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 long.
  - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
  - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  - 4. Spring hangers to support vertical runs.
  - 5. Copper-clad hangers 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: Maximum span, 60 inches; minimum rod size, 1/4 inch.

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2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.

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. 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.
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.

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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**

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SECTION 233113 – 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.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. 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 ASHRAE 62.1-2004.

1.4 SUBMITTALS

- A. Product Data: For each type of the following products:
  1. Liners and adhesives.

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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. 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 in congested spaces, 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.

D. Welding certificates.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. 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.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

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- C. 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. Ductwork shall be mechanical fastened and sealed. Mechanical fasteners for use with flexible non-metallic air ducts shall comply with UL 181B and shall be marked "181 B-C".
- 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."

### 2.2 SINGLE-WALL ROUND 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:
    - a. Lindab Inc.
    - b. McGill AirFlow LLC.
    - c. SEMCO Incorporated.
    - d. Sheet Metal Connectors, Inc.
    - e. Spiral Manufacturing Co., Inc.
- 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."



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1. Transverse Joints in Ducts Larger Than 60 Inches 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."
- 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."

## 2.3 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. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  1. Galvanized Coating Designation: G60.
  2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- 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. 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.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.4 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 one of the following:
    - a. CertainTeed Corporation; Insulation Group.
    - b. Johns Manville.

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- c. Knauf Insulation.
- d. Owens Corning.
- e. Maximum Thermal Conductivity:
  - 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
- 2. Water-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 diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches 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. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
  - 7. 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.
  - 8. 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.
    - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
  - 9. 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.

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2.5 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: 3 inches.
  - 3. Sealant: Modified styrene acrylic.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  - 7. Service: Indoor and outdoor.
  - 8. Service Temperature: Minus 40 to plus 200 deg F.
  - 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).
  - 11. Tape shall comply with UL 181B and shall be marked "181 B-FX".
- 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, 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.
  - 10. Sealant shall comply with UL 181B and shall be marked "181 B-M".
- D. 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).
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
  - 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.

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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.

## 2.6 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, "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.

## 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.

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- 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, 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.
- 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."

### 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.
- 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.

### 3.3 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."
- B. 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 C.
  - 4. Outdoor, Return-Air Ducts: Seal Class C.
  - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.

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6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

### 3.4 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 thick.
  4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "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 of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- 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.
- 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.

### 3.5 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.

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3.6 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.7 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: Test representative duct sections[, selected by Architect from sections installed,] totaling no less than 25 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 seven days' advance notice for testing.
- 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.

3.8 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE

- A. Supply Ducts:

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1. Ducts Connected to DOAS & Roof Top Units:
    - a. Pressure Class: Positive 3-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round and Flat Oval: 6.
  2. Ducts Connected to Fan Coil Units and Terminal Units:
    - a. Pressure Class: Positive 1-inch wg.
    - b. Minimum SMACNA Seal Class: C.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round and Flat Oval: 12.
  3. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive 2-inch wg.
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 3.
    - d. SMACNA Leakage Class for Round and Flat Oval: 3.
- B. Return Ducts:
1. Ducts Connected to DOAS Units, Roof Top Units:
    - a. Pressure Class: Positive or negative 3-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round and Flat Oval: 6.
  2. Ducts Connected to Fan Coil Units and Terminal Units:
    - a. Pressure Class: Positive or negative 1-inch wg.
    - b. Minimum SMACNA Seal Class: C.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - 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.
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 3.
    - d. SMACNA Leakage Class for Round and Flat Oval: 3.
- C. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
    - a. Pressure Class: Negative 1-inch wg.
    - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round and Flat Oval: 6.



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2. Ducts Connected to Commercial Kitchen Hoods and Commercial Dishwashers: Comply with NFPA 96.
    - a. Minimum 18 gauge, Type 316, stainless-steel sheet, No. 2D finish.
    - b. Welded seams and joints.
    - c. Pressure Class: Positive or negative 3-inch wg.
    - d. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
    - e. SMACNA Leakage Class: 3.
  3. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round and Flat Oval: 3.
- D. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
1. Ducts Connected to Fan Coil Units and Terminal Units:
    - a. Pressure Class: Positive or negative 1-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round and Flat Oval: 6.
  2. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive or negative 3-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 3.
    - d. SMACNA Leakage Class for Round and Flat Oval: 3.
- E. 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.
- F. Liner Schedule:
1. Provide acoustical lining 30 ft upstream and downstream of all air-handling unit equipment on supply and return ductwork, whether indicated on the drawings or not. Air handling equipment includes, but is not limited to, DOAS units and roof top units. If a branch takeoff occurs in the 10 ft, line entire takeoff. Provide acoustical lining for all outside air plenums, return air plenums and transfer ducts.
  2. Provide acoustical lining 10 ft downstream of all exhaust fans, whether indicated on the drawings or not.
  3. Provide acoustical lining 10 ft downstream of all VRF AHUs, whether indicated on the drawings or not.
  4. Liner type and thickness:
    - a. Supply Air Ducts: Fibrous glass, Type I, 1 inch thick.
    - b. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.

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- c. Exhaust Air Ducts: Fibrous glass, Type I, 1 inch thick.
- d. Supply Fan Plenums: Fibrous glass, Type II, 1 inch thick.
- e. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.

G. 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 or Lower:
    - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio and two vanes.
    - 2) Mitered Type RE 4 with vanes.
  - b. Velocity 1000 to 1500 fpm:
    - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with 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 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 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 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 or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
    - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
    - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
    - 4) Radius-to Diameter Ratio: 1.5.

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- b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
- c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

H. 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.
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." Saddle taps are permitted in existing duct.
  - a. Velocity 1000 fpm or Lower: Conical tap.
  - b. Velocity 1000 to 1500 fpm: Conical tap.
  - c. Velocity 1500 fpm or Higher: 45-degree lateral.

**END OF SECTION**

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SECTION 233116 – PRE-MANUFACTURED EXTERIOR DUCTING

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. Phenolic-foam ducts and fittings.

- B. Related Sections:

- 1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for nonmetal ducts.
  - 2. Section 233113 "Metal Ducts" for single- and double-wall, rectangular and round ducts.
  - 3. Section 233300 "Air Duct Accessories" for dampers, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Duct hangers and supports shall withstand the effects of gravity and wind loads and stresses within limits and under conditions described in SMACNA's "Phenolic Duct Construction Standards."
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 SUBMITTALS

- A. Product Data: For each type of the following products:

- 1. Phenolic-foam duct materials.

- B. Shop Drawings:

- 1. Product Data: Manufacturer's data sheets on each product to be used, including:
    - a. Physical properties, performance criteria, and product limitations.
    - b. Preparation instructions and recommendations.
    - c. Storage and handling requirements and recommendations.
    - d. Installation methods.

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2. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
3. Duct layout indicating sizes and 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. Hangers and supports, including methods for duct and building attachment and vibration isolation.
12. Installer qualifications.

C. 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 in congested spaces, 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.

D. Welding certificates.

E. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- C. Installer Qualifications: Pre-manufactured ducting shall be installed by experienced contractors who have received appropriate training for the installation of pre-insulated ducts and approved by the manufacturer or manufacturer's representative.

#### 1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.

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1. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PHENOLIC-FOAM DUCTS AND FITTINGS

#### A. Manufacturers:

1. Basis of Design: Dual-Tech and Techna-Duc System by PTM Manufacturing, LLC 800-455-1402.
2. Thermaduct LLC
3. Tuff Duct.

### 2.2 PRE-INSULATED HVAC DUCTWORK SYSTEM

- A. Pre-Insulated HVAC Ductwork System: Provide Kingspan KoolDuct® System for supply, return, fresh, and exhaust air ductwork as shown on the Drawings. System shall include panels, fabrication methods, coupling systems, and accessories to provide a complete system to meet the following performance criteria:
1. Classification: UL Listed as a Class 1 Air Duct, to UL 181, NFPA 90A and NFPA 90B
  2. 2015 SMACNA Phenolic Duct Construction Standards in combination with Kingspan Insulation certified fabrication standards.
  3. Fire and Smoke Performance when tested in accordance with ASTM E84 or UL 723:
    - a. Flame Spread:  $\leq 25$
    - b. Smoke Developed:  $\leq 50$
  4. Materials: CFC/HCFC free, zero Ozone Depletion Potential (ODP), fiber-free rigid thermoset phenolic insulation core faced with 1 mil low vapor permeability aluminum foil reinforced with glass scrim. Foil is branded on inside of duct and plain on the outer facing.
  5. Nominal Density: 3.4 to 3.75 pcf (55 to 60 kg/m<sup>3</sup>).
  6. Closed Cell Content: minimum 90 percent
  7. Compressive Strength: Minimum 29 psi (200 kPa) at 10 percent compression.
  8. Air Leakage: SMACNA Air Leakage Class 3.
  9. Mean Air Velocity: Maximum 5000 fpm (25.4 m/s) with all joints sealed.
  10. Design Pressures:
    - a. Positive Pressure: Maximum 4 inch w.g. (1000 Pa).
    - b. Negative Pressure: Maximum 3 inch w.g. (750 Pa).
  11. Commissioning Pressures - As designed to, max commissioning 4 inch w.g. (1000Pa.).
  12. Noise-Reduction Coefficient: 0.05 minimum when tested according to ASTM C 423, Mounting A.
  13. Temperature Range: Internal air temperature range -15 to 185 deg. F (-26 to 85 C) during continuous operation, inside ducts or ambient surrounding temperature.
  14. Thermal Resistance, Wall Thickness and R-Value:
    - a. 2-3/8" Double layer: R-16.2
    - b. Provide elastomeric foam liner: Provide acoustical lining 10 ft upstream and downstream of all energy recovery equipment on supply and return ductwork, whether indicated on the drawings or not. Air handling equipment includes, but is not limited to, air handling units, energy recovery units & roof top units
    - c. Thermal Conductivity: at 50 to 74 deg. F, mean 0.146 Btu inch per square foot per hour deg. F per ASTM C518.
  15. Typical Configuration: Rectangular.

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2.3 ACCESSORIES

- A. Fittings: In accordance with SMACNA Phenolic Duct Construction Standards or the ASHRAE Design Fundamentals Handbook Chapter 35 or the SMACNA HVAC Duct Systems Design Manual.
- B. Support Systems:
  - 1. Tiger Support and round galvanized wire or cable, or threaded rods.
  - 2. Galvanized steel channel support with round galvanized wire or cable, or threaded rods.
  - 3. Duct corner saddle with galvanized wire or cable.
- C. Coupling Systems:
  - 1. Tiger Clip Coupling System.
  - 2. Aluminum Grip Coupling System.
  - 3. 4-Bolt Coupling System.
- D. Dampers:
  - 1. Volume control dampers per 2015 SMACNA's Phenolic Duct Construction Standards. Per SMACNA, dampers in any ductwork greater than 12" in either dimension are required to be an opposed blade damper.
  - 2. Fire dampers.
- E. Access Doors:
  - 1. Metal insulated access doors.
- F. Turning Vanes:
  - 1. Where indicated, turning vanes shall be used in fittings to optimize airflow characteristics.
  - 2. Turing vanes shall be 2" double wall construction 26-gauge galvanized steel mounted on corresponding 2" rail.
- G. Reinforcement Systems:
  - 1. Kingspan Reinforcement system as dictated by the Kingspan KoolDuct® fabrication manual.
  - 2. ½" or ¾" EMT conduit reinforcements. Spacing requirements remain dictated by the Kingspan KoolDuct® fabrication manual.
- H. V-Groove sealant:
  - 1. Kingspan KoolDuct® sealant shall be used.
- I. Tape:
  - 1. Comply with UL 181A.
  - 2. Pressure-sensitive aluminum foil tape imprinted with manufacturer with UL markings, manufacturer name, and date.
  - 3. Minimum Width: 3 inch
  - 4. Water, mold, and mildew resistant.
- J. Kingspan KoolDuct® silicone sealant:
  - 1. Tiger clip coupling system
    - a. Kingspan KoolDuct® silicone sealant shall be used when joining duct segments together
- K. Self-Adhesive Gaskets:
  - 1. Aluminum Grip Coupling System
    - a. 15mm x 15mm gasket material as directed by Kingspan shall be used when joining duct segments together.
  - 2. 4-Bolt Coupling System

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- a. 15mm x 15mm gasket material as directed by Kingspan shall be used when joining duct segments together.

L. Duct Connections:

1. Factory Manufactured all Aluminum Grip Flange available profiles\*
  - a. Grip flange\*
  - b. F-flange\*
  - c. H-flange\*
  - d. U-flange\*
2. 4-Bolt Coupling System\*
3. Tiger coupling connection to be cleaned thoroughly, apply Kingspan KoolDuct® silicone sealant ensuring minimum air leakage and UL rated tape to be applied to external seams and rubbed down firmly to ensure a permanent, smooth, wrinkle-free bond.

\*NOTE: All aluminum grip coupling systems and 4 bolt flanged connections shall have a continuous strip of foam gasket material as per installation guidelines. Foam to be overlapped a minimum of 1" to ensure a complete seal.

2.4 FABRICATION

- A. Fabricate ductwork with panels, joints, seams, transitions, reinforcements, supports, elbows, connections, and accessories in accordance with SMACNA 2015 "Phenolic Duct Construction Standards" in combination with Kingspan Insulation certified fabrication.

2.5 FINISH

- A. Interior Ductwork - Standard Finish: Factory-applied aluminum foil vapor barrier facing.
- B. Exterior Ductwork – Dual-Tech® pre-fabricated, double layer ducting system utilizing the Kingspan KoolDuct® system. Ductwork shall consist of multiple layers to generate the required R-Value. See NON-FIBROUS, CLOSED CELL, EXTERIOR DUCTWORK AND INSULATION SYSTEM section.
  1. R-Values: 2-3/8" Double layer: R-16.2
  2. Exterior jacket shall be .032" Kynar 500 finished aluminum in a standard offering of colors.
- C. Exterior Duct Insulation – Techna-Duc® shall be a pre-manufactured panel system specifically manufactured for insulating exterior ductwork. The panel system shall be constructed with four-piece interlocking panels fabricated from a two layer laminated polyisocyanurate insulation system sealed in a vapor barrier with a weather proof jacket.
  1. R-Values: 2-3/8" Double layer: R-16.2
  2. Exterior jacket shall be .032" Kynar 500 finished aluminum in a standard offering of colors.

2.6 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.



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1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
  2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
  3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.
- C. Penetration into duct is not permitted.
- D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
1. Supports for Galvanized-Steel Ducts: Stainless-steel shapes and plates.
  2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
  3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

### 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 with fewest possible joints.
- C. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- D. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- E. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- F. 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. Overlap openings on four sides by at least 1-1/2 inches.
- G. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

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- H. Protect duct interiors from the moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."
- I. Install foam ducts and fittings to comply with manufacturer's guidelines.
- J. Ducting system sections shall be fitted into place and connected using aluminum flange and gasket as designed by manufacturer.
- K. Weather barrier shall be fabricated of mill finished embossed aluminum sheeting, 0.032" in thickness. Exposed seams to be covered with 1" butyl and a 8" embossed aluminum beaded bands, secured with #10 self-tapping, stainless screws with weather seal washers.
- L. At weather barrier abutment locations, and industrial grade RTV silicone caulk shall be utilized, where applicable.
- M. Seams exposed to the weather shall be covered and sealed with a 1" wide by 1/8" thick butyl compound.
- N. All screws utilized to fasten panel system together shall be #10 x 1/2" self-tapping, stainless steel, weather seal washer screws.
- O. Contact cement or 2-sided adhesive tape shall be utilized for laminating insulation material to the weather barrier sheeting.
- P. All internal seams must be fully sealed with an unbroken layer of silicone sealant.
- Q. Each ductwork section must be duly connected with a jointing system approved duct system manufacturer, and sufficient silicone sealant should be applied in order to seal the rigid phenolic insulation panel and ensure minimum air leakage
- R. Ductwork reinforcement, if necessary, shall be applied to protect against side deformation from both positive and negative pressure.
- S. All external seams where two separate panels join must be taped to achieve a permanent bond and a smooth wrinkle free appearance.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Install hangers and supports for phenolic-foam ducts and fittings to comply with manufacturer's guidelines.
- 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 thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  - 5. Do not use powder-actuated concrete fasteners for seismic restraints.

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- C. 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.

### 3.3 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "Phenolic Duct Construction Standards" for branch, outlet and inlet, and terminal unit connections.

### 3.4 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: Test representative duct sections, selected by Architect from sections installed, totaling no less than 25 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 seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
  - 1. Visually inspect duct system to ensure that no visible contaminants are present.
  - 2. Test sections of nonmetal 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.

### 3.5 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.

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- B. Clean all exterior aluminum jacketing during and after completion of construction.

3.6 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.7 DUCT SCHEDULE

- A. Outdoor Ducts and Fittings:

- 1. Phenolic-Foam Rectangular Ducts and Fittings:
  - a. Minimum Panel Thickness: 1-3/32 inches.
  - b. Aluminum Cladding: Minimum 0.032 inch thick.
  - c. Polymeric Sealing System: Coat ducts, including gang-nail couplings, grip flanges, and couplings.
- 2. Color: Selected by architect from the standard offering of colors.

**END OF SECTION**

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SECTION 233300 – 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. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Remote damper operators.
4. Fire dampers.
5. Flange connectors.
6. Turning vanes.
7. Duct-mounted access doors.
8. Flexible connectors.
9. Flexible ducts.
10. Duct accessory hardware.
11. Duct silencers.

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. 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. Wiring Diagrams: For power, signal, and control wiring.

- B. Performance Data for silencers:

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1. Silencer manufacturer to provide submittal drawings detailing all duct silencer data specified in the mechanical drawing schedule.
  2. The silencer manufacturer shall provide, for approval, acoustical system calculations for all duct systems with silencers to demonstrate that the submitted silencers will meet the required scheduled NC values in the occupied space. Use sound power levels of actual equipment to be installed on project. Analysis shall include breakout noise calculations.
  3. Supplier shall be responsible for the overall system pressure loss of the installation based on duct conditions upstream and downstream of the silencer to ensure required airflow is provided. Supplier shall submit detailed pressure drop analysis for the installation and detailed procedure outlining methodology for site measurement of overall system pressure loss for approval prior to manufacture.
    - a. Silencer internal design will provide ideal pressure drop value as scheduled
    - b. Installed pressure drop including system effect is maintained at maximum as scheduled.
  4. Acoustical and pressure drop calculations must be supplied with PE/P.Eng stamp at the time of submittal
- E. Source quality-control reports:
1. Silencer manufacturer to provide a copy of their laboratory NVLAP accreditation certificate for the ASTM E-477-06a test standard with the submittals. Data from non-NVLAP accredited test facilities will not be accepted.
- F. 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.
- G. Source quality-control reports.
- H. 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.
  - C. Silencer performance must have been substantiated by laboratory testing in a duct-to-reverberant room test facility according to ASTM E477-06a. The test facility must provide for airflow in both directions through the test silencer. The test set-up, procedure and facility shall eliminate all effects due to flanking, directivity, end reflection, standing waves and reverberation room absorption. The aero-acoustic laboratory must be currently NVLAP accredited for the ASTM E477-06a test standard.
  - D. Silencer manufacturer shall provide a written test report by a third party organization showing silencer assemblies have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.

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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.
  - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Greenheck Fan Corporation.
  - 2. Pottorff Company
  - 3. Ruskin Company.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 1-inch wg.
- E. Frame: 0.052-inch thick, galvanized sheet steel, with welded corners and mounting flange.
- F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Neoprene, mechanically locked.
- I. Blade Axles:

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1. Material: Nonferrous metal.
2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Galvanized steel.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball or synthetic pivot bushings.
- M. Accessories:
  1. Adjustment device to permit setting for varying differential static pressure.
  2. Counterweights and spring-assist kits for vertical airflow installations.
  3. Electric actuators.
  4. Chain pulls.
  5. Screen Mounting: Front mounted in sleeve.
    - a. Sleeve Thickness: 20-gage minimum.
    - b. Sleeve Length: 6 inches minimum.
  6. Screen Material: Galvanized steel.
  7. Screen Type: Insect.
  8. 90-degree stops.

## 2.3 MANUAL VOLUME DAMPERS

### A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. McGill AirFlow LLC.
  - b. Greenheck
  - c. Ruskin Company.
  - d. Pottorff Company
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:
  - a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
  - b. Mitered and welded corners.
  - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
  - a. Multiple or single blade.
  - b. Parallel- or opposed-blade design.
  - c. Stiffen damper blades for stability.
  - d. Galvanized-steel, 0.064 inch thick.



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6. Blade Axles: Nonferrous metal.
7. Bearings:
  - a. Oil-impregnated bronze.
  - b. Dampers in ducts with pressure classes of 3-inch wg 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.

B. Low-Leakage, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. McGill AirFlow LLC.
  - b. Greenheck
  - c. Pottorff Company
  - d. Ruskin Company.
2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
3. Suitable for horizontal or vertical applications.
4. Frames:
  - a. Hat shaped.
  - b. Galvanized-steel channels, 0.064 inch thick.
  - c. Mitered and welded corners.
  - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
  - a. Multiple or single blade.
  - b. Parallel- or opposed-blade design.
  - c. Stiffen damper blades for stability.
  - d. Galvanized, roll-formed steel, 0.064 inch thick.
6. Blade Axles: Nonferrous metal.
7. Bearings:
  - a. Oil-impregnated bronze.
  - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Blade Seals: Neoprene.
9. Jamb Seals: Cambered stainless steel.
10. Tie Bars and Brackets: Galvanized steel.
11. Accessories:
  - a. Include locking device to hold single-blade dampers in a fixed position without vibration.

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## 2.4 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Greenheck Fan Corporation.
  - 2. Pottorff.
  - 3. Ruskin Company.
- C. Description: Cable system designed for remote manual damper adjustment.
- D. Construction:
  - 1. Frame: 6" x minimum 22 gauge (152 mm x 0.85 mm), roll formed galvanized steel with reinforcing beads at each end.
  - 2. Blade: Round, minimum 22 gauge (0.85 mm), galvanized steel with center formed V for added rigidity. Flat blades are not acceptable.
  - 3. Axles: Minimum 3/8" (10 mm) square plated steel, mechanically attached to blade.
  - 4. Bearings: Molded synthetic, sleeve-type turning in tight sealing hole in frame.
  - 5. Mounting: Vertical and/or Horizontal
  - 6. Actuator: Remote cable controlled quadrant shall be factory installed to the damper, attached to a minimum 36 inch (914 mm) long flexible cable controlled, and controlled by a 3/16 inch (4.8 mm) allen hex-head drive with 15/16 inch (24 mm) round white finishing plug (suitable for painting) and integral side-mounting flange. The entire assembly shall be factory assembled and tested prior to shipment, field assembled systems are not acceptable.
  - 7. Finish: Mill galvanized.
- E. Accessories:
  - 1. Extended cable length as required.
  - 2. Hex-wrench.

## 2.5 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Greenheck Fan Corporation.
  - 2. Pottorff.
  - 3. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Fire Rating: 3 hours.
- E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
  - 1. Minimum Thickness: 0.05 inch 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.

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- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.024-inch thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

## 2.6 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: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

## 2.7 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. SEMCO Incorporated.
- 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. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. 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."
- E. Vane Construction: Double wall.
- F. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

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2.8 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ductmate Industries, Inc.
  - 2. Greenheck Fan Corporation.
  - 3. McGill AirFlow LLC.
- 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 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 Square: No hinges and two sash locks.
    - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
    - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
    - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.9 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ductmate Industries, Inc.
  - 2. Flame Gard, Inc.
  - 3. 3M.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0428-inch stainless steel.
- D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

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2.10 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 wide attached to 2 strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch 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..
  - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
  - 3. Service Temperature: Minus 40 to plus 200 deg F.
- 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..
  - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
  - 3. Service Temperature: Minus 50 to plus 250 deg F.
- 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 movement at start and stop.

2.11 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Flexmaster U.S.A., Inc.
  - 2. McGill AirFlow LLC.

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3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

- B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 10-inch wg positive.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

- 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, to suit duct size.

## 2.12 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.

## 2.13 DUCT SILENCERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Vibro-Acoustics.
  2. Alternate manufacturers must request and obtain written approval by the Engineer to bid the project at least 10 days prior to the bid due-date. As a condition of pre-approval, alternate manufacturers must submit to the Engineer a minimum of twenty (20) different HVAC silencer test reports. Each report shall be for a silencer tested in full accordance with the ASTM E-477-06a silencer test standard in an aero-acoustic test facility which is NVLAP accredited for the ASTM E-477-06a standard. Each test shall have been conducted within the last 12 month period. A copy of the laboratory's NVLAP accreditation certificate must be included with the submitted reports. Any changes to the specifications must be submitted and approved in writing by the Engineer at least 10 days prior to the bid due-date.
- B. General Requirements:
  1. Silencers shall be of the size, configuration, capacity and acoustic performance as scheduled on the drawings. All silencers shall be factory fabricated and supplied by the same manufacturer.
  2. Silencer inlet and outlet connection dimensions must be equal to the duct sizes shown on the drawings. Duct transitions at silencers are not permitted unless shown on the contract drawings.
  3. Silencers shall be constructed in accordance with ASHRAE and SMACNA standards for the pressure and velocity classification specified for the air distribution system in which it is installed. Material gauges noted in other sections are minimums. Material gauges shall be increased as required for the system pressure and velocity classification. The silencers shall not fail structurally when subjected to a differential air pressure of 8 inches water gauge.

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4. All casing seams and joints shall be lock-formed and sealed or stitch welded and sealed except as noted in Section G below, to provide leakage-resistant construction. Airtight construction shall be achieved by use of a duct-sealing compound supplied and installed by the contractor at the jobsite.
  5. All perforated steel shall be adequately stiffened to insure flatness and form. All spot welds shall be painted.
  6. Fire-Performance Characteristics: Silencer assemblies, including acoustic media fill, Vibar™ film liner, sealants, and acoustical spacer, shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.
  7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Rectangular Silencers including models RD and RED: Outer casing shall be ASTM A 653/A 653M, G90 galvanized sheet steel, 22 gauge and 18 gauge respectively. Inner perforated metal liner: ASTM A 653/A 653M, G90 galvanized sheet steel, Gauge 26 and Gauge 22
- D. Principal Sound-Absorbing Mechanism:
1. Dissipative silencers:
    - a. Models RD, RED and EX-RD type with acoustic media. Media shall be of acoustic quality, shot-free glass fiber insulation with long, resilient fibers bonded with a thermosetting resin. Glass fiber density and compression shall be as required to insure conformance with laboratory test data. Glass fiber shall be packed with a minimum of 15% compression during silencer assembly. Media shall be resilient such that it will not crumble or break, and conform to irregular surfaces. Media shall not cause or accelerate corrosion of aluminum or steel. Mineral wool will not be permitted as a substitute for glass fiber.
- E. Media Protection:
1. Dissipative silencers, including models RD, RED and EX-RD: Where indicated on the silencer schedule, media shall be encapsulated in glass fiber cloth to help prevent shedding, erosion and impregnation of the glass fiber.
- F. HTL Casings: Where indicated on the silencer schedule, silencers shall have high transmission loss (HTL) walls externally applied and completely sealed to the silencer casing by the silencer manufacturer to assure quality controlled transmission loss. The HTL walls shall consist of media, airspace, mass and outer protective metal skin, as required, to obtain the specified room noise criteria. Standard acoustical panels will not be accepted as HTL walls. If requested by the Engineer, breakout noise calculations for each air handling and fan system shall be provided with the silencer submittal to insure compliance with the room noise criteria. Breakout noise calculations shall be based on the sound power levels of the specified equipment.
- G. Accessories:
1. Factory-installed end caps to prevent contamination during shipping.

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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 backdraft 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 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 and downstream 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 or smoke 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. At each change in direction and at maximum 50-foot spacing.
  - 8. Upstream and downstream from turning vanes.
  - 9. Upstream or downstream from duct silencers.
  - 10. Control devices requiring inspection.
  - 11. Elsewhere as indicated.
- H. Install access doors with swing against duct static pressure.
- I. Access Door Sizes:
  - 1. One-Hand or Inspection Access: 8 by 5 inches.
  - 2. Two-Hand Access: 12 by 6 inches.
  - 3. Head and Hand Access: 18 by 10 inches.



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4. Head and Shoulders Access: 21 by 14 inches.
  5. Body Access: 25 by 14 inches.
  6. Body plus Ladder Access: 25 by 17 inches.
- J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- K. Install flexible connectors to connect ducts to equipment.
- L. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- M. Connect supply diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- N. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.
- O. Install duct test holes where required for testing and balancing purposes.
- P. Provide remote damper operators where ever volume dampers are installed above an inaccessible hard ceiling.
- Q. Install silencer according to manufacturer's written installation instructions.

### 3.2 ADJUSTMENT, CALIBRATION, AND TESTING

- A. Description:
1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
  2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
  3. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
  4. Equipment and procedures used for calibration shall meet instrument manufacturer's recommendations.
  5. Provide diagnostic and test equipment for calibration and adjustment.
  6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
  7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
  8. If after-calibration-indicated performance cannot be achieved, replace out-of-tolerance instruments.
  9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

### 3.3 FIELD QUALITY CONTROL

- A. Tests and Inspections:

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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.
6. Ensure duct silencers are installed with airflow arrows in direction

**END OF SECTION**

SECTION 233423 – 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. Section Includes:
  - 1. Centrifugal roof ventilators.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also 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. Dampers, including housings, linkages, and operators.
  - 6. Roof curbs.
  - 7. Fan speed controllers.
- B. Shop Drawings: 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.
- C. Coordination Drawings: Reflected ceiling 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. 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.

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- 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

D. Field quality-control 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, by a qualified testing agency, and marked for intended location and application.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

#### 1.6 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

#### 1.7 WARRANTY

A. Manufacturer shall provide, at no additional cost, a standard parts warranty that covers a period of two years from substantial completion. This warrants that all products are free from defects in material and workmanship and shall meet the capacities and ratings set forth in the equipment manufacturer's catalog and bulletins.

### PART 2 - PRODUCTS

#### 2.1 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Greenheck Fan Corporation.
- 2. Loren Cook Company.
- 3. PennBarry.

B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

- 1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

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- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- A. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.
- B. Accessories:
  - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
  - 2. Disconnect Switch: Nonfusible type, with thermal-overload protection, factory wired through an internal aluminum conduit.
  - 3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
  - 4. Restaurant Kitchen Exhaust: UL 762 listed for grease-laden air exhaust.
  - 5. Roof Curb
  - 6. Grease cup.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- C. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops having a static deflection of 1 inch.
- D. Install units with clearances for service and maintenance.
- E. 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 tests and inspections.

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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. 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. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

**END OF SECTION**

SECTION 233713 – 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. Fixed face grilles.
  - 3. Ceiling linear slot outlets and returns.
- 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.
- B. 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.
- C. Source quality-control reports.

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PART 2 - PRODUCTS

2.1 LOUVERED FACE DIFFUSERS

A. Louver Face Diffuser Tag-A:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Price.
  - b. Titus.
  - c. Krueger.
2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel.
4. Finish: Baked enamel, white.
5. Face Size: 24x24.
6. Mounting: As required for ceiling type.
7. Pattern: Refer to drawings.
8. Accessories:
  - a. Round to square transition
  - b. Lay-in panel

2.2 REGISTERS AND GRILLES

A. Fixed Face Bar Grille with Filter, Tag-B:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Price.
  - b. Titus.
  - c. Krueger.
2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
5. Core Construction: Integral.
6. Frame: 1-1/4 inches wide.
7. Mounting: Countersunk screw.
8. Accessories:
  - a. Opposed blade damper for all concealed gypsum board installations.
  - b. Knurled knob 1" filter frame with MERV 8 filter

B. Adjustable Bar Grille, Tag-C:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Price.



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- b. Titus.
    - c. Krueger.
  - 2. Material: Steel.
  - 3. Finish: Baked enamel, in color chosen by the architect.
  - 4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
  - 5. Core Construction: Integral.
  - 6. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.
  - 7. Frame: 1-1/4 inches wide.
  - 8. Mounting: Countersunk screw.
- C. Heavy Duty Fixed Face Bar Grille, Tag-D:
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Price.
    - b. Titus.
    - c. Krueger.
  - 2. Material: Steel.
  - 3. Finish: Baked enamel. Provide in color chosen by architect.
  - 4. Face Blade Arrangement: Horizontal spaced 3/8 inch apart with 0 degree deflection.
  - 5. Core Construction: Integral.
  - 6. Frame: 1-1/4 inches wide.
  - 7. Mounting: Countersunk screw.

## 2.3 CEILING LINEAR SLOT OUTLETS

- A. Linear Slot Diffuser, Tag-E:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Price.
    - b. Titus.
    - c. Krueger.
  - 2. Material - Shell: Aluminum.
  - 3. Material - Pattern Controller and Tees: Aluminum.
  - 4. Finish - Face and Shell: Baked enamel, black
  - 5. Finish - Pattern Controller: Baked enamel, black.
  - 6. Finish - Tees: Baked enamel, in color selected by Architect.
  - 7. Slot Width: 3/4 inch.
  - 8. Number of Slots: Four.
  - 9. Length: Refer to drawings.
  - 10. Accessories:
    - a. Insulated Plenum.
    - b. Blank-offs for all inactive lengths.

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11. Plenum: Field fabricated plenum boxes with fiber-free insulation. Refer to drawings for dimensions, location, and further details.

## 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.

### 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**

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SECTION 237433 – ROOF TOP 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 factory-packaged outdoor rooftop units capable of supplying up to 100 percent outdoor air and providing cooling and heating.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rated capacities, operating characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, 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. Prepare the following by or under the supervision of a qualified professional engineer:
    - a. Mounting Details: For securing and flashing roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
    - b. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof-curb mounting 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. Size and location of unit-mounted rails and anchor points and methods for anchoring units to roof curb.
  - 2. Required roof penetrations for ducts, pipes, and electrical raceways, including size and location of each penetration.
- B. Startup service reports.
- C. Sample Warranty: For special warranty.

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1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Compressors: Five years from date of Substantial Completion.
  - 2. Two-year warranty on parts and labor. Warranties will begin after Substantial Completion.
  - 3. Warranty Period for Heat Exchangers: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AAON.

2.2 PERFORMANCE REQUIREMENTS

- A. General Fabrication Requirements: Comply with requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Start-up."
  - 1. Unit shall be certified in accordance with UL Standard 1995/CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.
  - 2. Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.
  - 3. Unit shall be certified in accordance with ANSI Z21.47b/CSA 2.3b and ANSI Z83.8/CSA 2.6, Safety Standard Gas-Fired Furnaces.
  - 4. Unit shall be certified in accordance with UL Standard 1995/CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.
  - 5. Unit shall be safety certified by ETL and ETL US listed. Unit nameplate shall include the ETL/ETL Canada label.
- B. Cabinet Surface Condensation:
  - 1. Cabinet shall have additional insulation and vapor seals if required to prevent condensation on the interior and exterior of the cabinet.
  - 2. Portions of cabinet located downstream from the cooling coil shall have a thermal break at each thermal bridge between the exterior and interior casing to prevent condensation from occurring on the interior and exterior surfaces. The thermal break shall not compromise the structural integrity of the cabinet.
- 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.

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## 2.3 Rooftop Units

### A. General Description

1. Packaged rooftop unit shall include compressors, evaporator coils, filters, supply fans, dampers, air-cooled condenser coils, condenser fans, reheat coil, gas heaters, electric heaters, exhaust fans, energy recovery wheels, and unit controls.
2. Unit shall be factory assembled and tested including leak testing of the DX coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the service compartment's literature pocket.
3. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
4. Unit components shall be labeled, including refrigeration system components and electrical and controls components.
5. Estimated sound power levels (dB) shall be shown on the unit schedule.
6. Installation, Operation and Maintenance manual shall be supplied within the unit.
7. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.
8. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

### B. Construction

1. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.
2. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D-1929 for a minimum flash ignition temperature of 610°F.
3. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.
4. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

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5. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
6. Access to filters, dampers, cooling coils, reheat coil, heaters, exhaust fans, energy recovery wheels, compressors, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.
7. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
8. Units with cooling coils shall include double sloped 304 stainless steel drain pans.
9. Unit shall be provided with base discharge and return air openings. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch in height around the opening.
10. Unit shall include lifting lugs on the top of the unit.
11. Unit base pan shall be provided with 1/2 inch thick foam insulation.

C. Electrical

1. Unit shall be provided with factory installed and factory wired, non-fused disconnect switch.
2. Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.
3. Unit shall be provided with a factory installed and factory wired 115V, 13 amp GFI outlet disconnect switch in the unit control panel.

D. Supply Fans

1. Unit shall include direct drive, unhooded, backward curved, plenum supply fans.
2. Blowers and motors shall be dynamically balance and mounted on rubber isolators.
3. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.
4. Variable frequency drives shall be factory wired and mounted in the unit. The VFD frequency signal control point must be able to handle a 20K ohm input impedance. Fan motors shall be premium efficiency.

F. Exhaust Fans

1. Exhaust dampers shall be sized for 100% relief.
2. Fans and motors shall be dynamically balanced.
3. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.
4. Access to exhaust fans shall be through double wall, hinged access doors with quarter turn lockable

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handles.

5. Unit shall include belt driven, unhooded, backward curved, plenum exhaust fans.
6. Variable frequency drives shall be factory wired and mounted in the unit. The VFD frequency signal control point must be able to handle a 20K ohm input impedance. Fan motors shall be premium efficiency.

G. Cooling Coils

1. Evaporator Coils
  - a. Coils shall be designed for use with R-454B refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.
  - b. Coils shall be 6 row high capacity
  - c. Coils shall have interlaced circuitry and shall be 6 row high capacity.
  - d. Coils shall be helium leak tested.
  - e. Coils shall be furnished with factory installed thermostatic expansion valves.

G. Refrigeration System

1. Unit shall be factory charged with R-454B refrigerant.
2. Compressors shall be scroll type with thermal overload protection and independently circuited.
3. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam injected panels to prevent the transmission of noise outside the cabinet.
4. Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.
5. Each refrigeration circuit shall be equipped with thermostatic expansion valve type refrigerant flow control.
6. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides and a factory installed replaceable core liquid line filter driers.
7. Unit shall include a variable capacity scroll compressor on the refrigeration circuit which shall be capable of modulation from 10-100% of its capacity.
8. Unit shall include a variable capacity scroll compressor on the lead refrigeration circuit which shall be capable of modulation from 10-100% of its capacity where there is more than one compressor indicated.
9. Refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic control-

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ler, supply air temperature sensor and a control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space.

10. Lead refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space where there is more than one compressor indicated.

11. Each refrigeration circuit shall be equipped with suction and discharge compressor isolation valves.

12. Each refrigeration circuit shall include adjustable compressor lockouts.

13. First capacity stage shall be provided with on/off condenser fan cycling and adjustable compressor lockout to allow cooling operation down to 35°F.

14. Reversing valve for air-source heat pump operation.

#### H. Condensers

##### 1. Air-Cooled Condenser

- a. Condenser fans shall be a vertical discharge, axial flow, variable speed direct drive fans.
- b. Coils shall be designed for use with R-454B refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled.
- c. Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.
- d. Coils shall be helium leak tested.
- e. Condenser fans shall be VFD driven variable speed for condenser head pressure control. Factory provided and factory programmed VFDs shall continuously modulate the fan air flow to maintain head pressure at acceptable levels. Cooling operation shall be allowed down to 35°F with adjustable compressor lockouts.

#### I. Gas Heating

1. Gas furnace shall consist of stainless steel heat exchangers with multiple concavities, an induced draft blower and an electronic pressure switch to lockout the gas valve until the combustion chamber is purged and combustion airflow is established.
2. Furnace shall include a gas ignition system consisting of an electronic igniter to a pilot system, which will be continuous when the heater is operating, but will shut off the pilot when heating is not required.
3. Unit shall include a single gas connection and have gas supply piping entrances in the unit base for through-the-curb gas piping and in the outside cabinet wall for across the roof gas piping.
4. Natural gas furnace shall be equipped with modulating gas valves, adjustable speed combustion blowers, stainless steel tubular heat exchangers, and electronic controller. Combustion blowers and gas valves shall be capable of modulation. Electronic controller includes a factory wired, field in-



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stalled supply air temperature sensor. Sensor shall be field installed in the supply air ductwork. Supply air temperature setpoint shall be adjustable on the electronic controller within the controls compartment. Gas heating assemblies shall be capable of operating at any firing rate between 100% and 10% of their rated capacity

I. Filters

1. Unit shall include 2 inch thick, pleated panel filters with an ASHRAE MERV rating of 13, upstream of the cooling coil.
2. Unit shall include 1 inch MERV 8 pre filters upstream of the outside air opening.
3. Units shall include a Magnehelic gauge mounted in the controls compartment.

J. Outside Air/Economizer

1. Unit shall include 100% motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 15 CFM of leakage per sq. ft. of damper area when subjected to 2 inches w.g. air pressure differential across the damper. Damper assembly shall be controlled by spring return, 2 position actuator. Unit shall include outside air opening bird screen and outside air hood with rain lip.

K. Energy Recovery

1. Unit shall contain a factory mounted and tested energy recovery wheels. The energy recovery wheels shall be mounted in a rigid frame containing the wheel drive motor, drive belt, wheel seals and bearings. Frame shall slide out for service and removal from the cabinet.
2. The energy recovery component shall incorporate a rotary wheel in an insulated cassette frame complete with seals, drive motor and drive belt.
3. Wheels shall be wound continuously with one flat and one structured layer in an ideal parallel plate geometry providing laminar flow and minimum pressure drop-to-efficiency ratios. The layers shall be effectively captured in stainless steel wheel frames or aluminum and stainless steel segment frames that provide a rigid and self-supporting matrix.
4. Wheels shall be provided with removable energy transfer matrix. Wheel frame construction shall be a welded hub, spoke and rim assembly of stainless, plated and/or coated steel and shall be self-supporting without matrix segments in place. Segments shall be removable without the use of tools to facilitate maintenance and cleaning. Wheel bearings shall be selected to provide an L-10 life in excess of 400,000 hours. Rim shall be continuous rolled stainless steel and the wheel shall be connected to the shaft by means of taper locks.
5. All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set. Drive belts of stretch urethane shall be provided for wheel rim drive without the need for external tensioners or adjustment.
6. The energy recovery cassette shall be an Underwriters Laboratories Recognized Component for electrical and fire safety. The wheel drive motor shall be an Underwriters Laboratory Recognized Com-

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ponent and shall be mounted in the cassette frame and supplied with a service connector or junction box. Thermal performance shall be certified by the manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and AHRI Standard 1060, Rating Air-to-Air Energy Recovery Ventilation Equipment. Cassettes shall be listed in the AHRI Certified Products.

7. Energy recovery wheel cassette shall carry a 5 year non-prorated warranty, from the date of original equipment shipment from the factory. The first 12 months from the date of equipment startup, or 18 months from the date of original equipment shipment from the factory, whichever is less, shall be covered under the standard AAON limited parts warranty. The remaining period of the warranty shall be covered by Airxchange. The 5 year warranty applies to all parts and components of the cassette, with the exception of the motor, which shall carry an 18 month warranty. Warranty shall cover material and workmanship that prove defective, within the specified warranty period, provided the Airxchange written instructions for Installation, Operation, and Maintenance have been followed. Warranty excludes parts associated with routine maintenance, such as belts. Refer to the Airxchange Energy Recovery Cassette Limited Warranty Certificate.
8. Hinged service access doors shall allow access to the wheels.
9. Total energy recovery wheels shall be coated with silica gel desiccant permanently bonded by a process without the use of binders or adhesives, which may degrade desiccant performance. The substrate shall be lightweight polymer and shall not degrade nor require additional coatings for application in marine or coastal environments. Coated segments shall be washable with detergent or alkaline coil cleaner and water. Desiccant shall not dissolve nor deliquesce in the presence of water or high humidity.
10. Unit shall include energy recovery wheel defrost control which includes an adjustable temperature sensor and timer wired to periodically stop the wheel rotation, which allows the warm exhaust air to defrost the wheel.
11. Unit shall include energy recovery wheel rotation detection sensors and a set of normally open and normally closed contacts for field indication of wheel rotation.

L. Roof Curb

1. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
2. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
3. Materials: ASTM C 1071, Type I or II.
4. Insulation Thickness: 1 inch.

2.4 CONTROLS

- A. Control Wiring: Factory wire connection for controls' power supply.
- B. Control Devices: Sensors, transmitters, relays, switches, detectors, operators, actuators, and valves shall be manufacturer's standard items to accomplish indicated control functions.
- C. Control Damper:

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1. Damper Location: Factory installed inside unit for ease of blade axle and bushing service. Arrange dampers located in a mixing box to achieve convergent airflow to minimize stratification.
2. Damper Leakage: Comply with requirements in AMCA 500-D. Leakage shall not exceed 6.5 cfm per sq. ft. at a static-pressure differential of 4.0 inches water column when a torque of 5 inch pounds per sq. ft. is applied to the damper jackshaft.
3. Damper Rating: Rated for close-off pressure equal to the fan shutoff pressure.
4. Damper Label: Bear the AMCA seal for both air leakage and performance.
5. Blade Configuration: Unless otherwise indicated, use parallel blade configuration for two-position control and equipment isolation service.
6. Damper Frame Material: Extruded aluminum.
7. Blade Type: Single-thickness metal reinforced with multiple V-grooves or hollow-shaped airfoil.
8. Blade Material: Extruded aluminum.
9. Blade Seals: Replaceable, continuous perimeter vinyl seals and jambs with stainless-steel compression-type seals.
10. Bearings: Thrust bearings for vertical blade axles.

D. Damper Operators:

1. Factory-installed electric operator for each damper assembly with one operator for each damper assembly mounted to the damper frame.
2. Maximum Operating Time: Open or close damper 90 degrees in 60 seconds.
3. Adjustable Stops: For both maximum and minimum positions.
4. Spring-return operator to fail-safe; either closed or open as required by application.
5. Operator Type: Direct coupled, designed for minimum 60,000 full-stroke cycles at rated torque.
6. Position feedback Signal: For remote monitoring of damper position.
7. Coupling: V-bolt and V-shaped, toothed cradle.
8. Circuitry: Electronic overload or digital rotation-sensing circuitry.

E. Refrigeration System Controls:

1. Unit-mounted enthalpy controller shall lock out refrigerant system when outdoor-air enthalpy is less than 28 Btu/lb of dry air or outdoor-air temperature is less than 60 deg F.

F. The unit must be supplied with a terminal strip for control by the ATC contractor. Control equipment and sequence of operation are specified in Section 230900 "Instrumentation and Control for HVAC." And mechanical control drawings. Except as otherwise noted above for Refrigeration noted above. Unitary controller and/or BACnet interface provided by the unit manufacturer will not be accepted.

G. Terminals Available: The following terminals shall be provided for control of unit: Refer to DWG M400 series drawings for terminals required for control.

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 piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

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- C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.
- B. Curb Support: Install roof curb on roof structure according to "The NRCA Roofing Manual."
  - 1. Install and secure units on curbs and coordinate roof penetrations and flashing with roof construction.
  - 2. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."
  - 3. Coordinate size, location, and installation of unit manufacturer's roof curbs and equipment supports with roof Installer.
  - 4. Provide curbs complete with service platforms where indicated on contract drawings.
- C. Install wall- and duct-mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.
- D. Comply with requirements for gas-fired furnace installation in NFPA 54, "National Fuel Gas Code."
- E. Install separate devices furnished by manufacturer and not factory installed.
- F. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

### 3.3 CONNECTIONS

- A. Where installing piping adjacent to units, allow space for service and maintenance.
- B. Duct Connections:
  - 1. Comply with requirements in Section 233113 "Metal Ducts."
  - 2. Comply with requirements in Section 233116 "Pre-manufactured exterior ducting."
  - 3. Drawings indicate the general arrangement of ducts.
  - 4. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 233300 "Air Duct Accessories."
- C. Comply with requirements for gas-fired furnace installation in NFPA 54, "National Fuel Gas Code."
- D. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.
  - 1. Install electrical devices furnished by unit manufacturer but not factory mounted.

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3.4 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 units for visible damage to furnace combustion chamber.
  3. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency:
    - a. Measure gas pressure at manifold.
    - b. Measure combustion-air temperature at inlet to combustion chamber.
    - c. Measure flue-gas temperature at furnace discharge.
    - d. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
    - e. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
  4. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
    - a. High-limit heat exchanger.
    - b. Alarms.
  5. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
  6. Start refrigeration system when outdoor-air temperature is within normal operating limits and measure and record the following:
    - a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
    - b. Cooling coil entering-air, dry- and wet-bulb temperatures.
    - c. Condenser coil entering-air dry-bulb temperature.
    - d. Condenser coil leaving-air dry-bulb temperature.
  7. Simulate maximum cooling demand and inspect the following:
    - a. Compressor refrigerant suction and hot-gas pressures.
    - b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.
  8. Inspect casing insulation for integrity, moisture content, and adhesion.
  9. Verify that clearances have been provided for servicing.
  10. Verify that controls are connected and operable.
  11. Verify that filters are installed.
  12. Clean coils and inspect for construction debris.
  13. Clean furnace flue and inspect for construction debris.
  14. Inspect operation of power vents.
  15. Purge gas line.
  16. Inspect and adjust vibration isolators and seismic restraints.
  17. Verify bearing lubrication.
  18. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
  19. Adjust fan belts to proper alignment and tension.
  20. Start unit.

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21. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
22. Operate unit for run-in period.
23. Calibrate controls.
24. Adjust and inspect high-temperature limits.
25. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
26. Verify operational sequence of controls.
27. Measure and record the following airflows. Plot fan volumes on fan curve.

- a. Supply-air volume.
- b. Return-air flow.
- c. Outdoor-air flow.

- B. After startup, change filters, verify bearing lubrication, and adjust belt tension.
- C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.
- D. Prepare written report of the results of startup services.

### 3.5 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Occupancy Adjustments: When requested within 12 months from 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.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

**END OF SECTION**

SECTION 238126 – SPLIT-SYSTEM AIR-CONDITIONERS

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 split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting and may be connected to ducts.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.
- F. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.5        COORDINATION

- A.     Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."
- B.     Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations 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 split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  - 1.     Warranty Period: Two years from date of Substantial Completion except compressor five years from substantial completion.

PART 2 - PRODUCTS

2.1        MANUFACTURERS

- A.     Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1.     Daiken

2.2        CONCEALED EVAPORATOR-FAN COMPONENTS

- A.     Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
  - 1.     Insulation: Faced, glass-fiber duct liner.
  - 2.     Drain Pans: Galvanized steel, with connection for drain; insulated and complying with ASHRAE 62.1.
  - 3.     Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- B.     Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.
- C.     Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
- D.     Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  - 1.     Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.
- E.     Filters: Permanent, cleanable.



- F.     Wiring Terminations: Connect motor to chassis wiring with plug connection.

## 2.3        EVAPORATOR-FAN COMPONENTS

- A.     Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
  - 1.     Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
  - 2.     Drain Pan and Drain Connection: Comply with ASHRAE 62.1.
- B.     Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.
- C.     Fan: Direct drive, centrifugal fan.
- D.     Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  - 1.     Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.
- E.     Filters: Permanent, cleanable.

## 2.4        AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

- A.     Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- B.     Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
  - 1.     Compressor Type: DC Rotary.
  - 2.     Variable Compressor speed inverter technology with manual-reset high-pressure switch and automatic-reset low-pressure switch.
  - 3.     Refrigerant: R-410A.
- C.     Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.
- D.     Heat Pump Components: Reversing valve and low-temperature air cut-off thermostat for CU-4 only.
- E.     Fan: Aluminum-propeller type, directly connected to motor.
- F.     Motor: Permanently lubricated, with integral thermal-overload protection.
- G.     Low Ambient Kit: Permits operation down to 0 deg F.
- H.     Mounting Base: Roof mounted equipment supports.

- I. Minimum Energy Efficiency: Comply with ASHRAE/IESNA 90.1, "Energy Standard for Buildings except Low-Rise Residential Buildings."

## 2.5 ACCESSORIES

- A. Thermostat: Hard wired functioning to remotely control compressor and evaporator fan, with the following features:
  1. Compressor time delay.
  2. 24-hour time control of system stop and start.
  3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
  4. Fan-speed selection, including auto setting.
- B. Automatic-reset timer to prevent rapid cycling of compressor.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounting compressor-condenser components on equipment supports specified in Division 07 Section "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

### 3.2 CONNECTIONS

- A. Install piping adjacent to unit to allow service and maintenance.
- B. Duct Connections: Duct installation requirements are specified in Division 23 Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect outside air ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Air Duct Accessories."
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.

3.3        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.    Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2.    Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3.    Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C.    Remove and replace malfunctioning units and retest as specified above.

3.4        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.

3.5        DEMONSTRATION

- A.    Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Division 01 Section "Demonstration and Training."

**END OF SECTION**

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SECTION 238127 – VARIABLE REFRIGERANT FLOW 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 SYSTEM DESCRIPTION AND GENERAL REQUIREMENTS

- A. Variable Refrigerant Flow (VRF) HVAC system shall be a variable capacity, direct expansion (DX) heat recovery and heat pump engineered system. The outdoor unit shall consist of one or more cabinet(s) connected through common refrigerant piping. Each system shall have single or multiple, inverter compressor(s). Each system shall be connected to multiple indoor units (ducted, non-ducted or combination thereof) through a common refrigerant piping and integrated system controls. Each indoor unit shall be controlled individually. Additionally heat recovery system shall be capable of simultaneous heating and cooling individual zone(s).
  - 1. Simultaneous Cooling and Heating VRF System: Heat recovery system shall be an air cooled, system consisting of one to three outdoor unit(s) connected to Heat Recovery (HRU) unit(s) and indoor unit(s). Multi-port heat recovery units shall allow simultaneous heating and cooling of individual zone(s).
- B. The manufacturer shall provide the services of a Factory Authorized Service Engineer to provide complete start-up supervision. The Manufacturer's Representative shall provide a minimum of 16-hours of BACnet integration assistance with the owner's building automation contractor.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, sequence of operations and electrical characteristics.
- B. Shop Drawings: 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

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1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Organization for Standardization (ISO).
- B. All electrical power wiring shall be installed in accordance with the National Electrical Code (NEC) and all applicable state and local building codes.
- C. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label and comply with UL 1995 Heat and Cooling Equipment Standard for Safety.
- D. All systems must be AHRI 1230 Certified and listed in the certified product directory.
- E. The VRF system shall be installed by a licensed mechanical contractor trained by the VRF equipment manufacturer or certified manufacturer's agent. If contractor is not licensed by VRF equipment manufacturer as an approved installer then contractor shall provide written proof of certification prior to the start of installation.

1.7 STORAGE AND HANDLING

- A. All VRF equipment shall be stored protected from weather, extreme temperature, etc. as suggested by the manufacturer. All VRF equipment shall be moved, lifted, etc. as suggested by the manufacturer.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. For Compressor: Five year(s) from date of Substantial Completion.
    - b. For Parts: Two year(s) from date of Substantial Completion.
    - c. For Labor: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Daiken VRF (Tim McGraw at TriState – 610-825-4770)

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## 2.2 SIMULTANEOUS HEATING AND COOLING SYSTEM

### A. SYSTEM DESCRIPTION:

1. The variable capacity heat pump air conditioning system shall be a Daikin Variable Refrigerant Volume Series (heat or cool model) system as specified.
2. The system shall consist of multiple evaporators using PID control, REFNET™ joints and headers, a two-pipe refrigeration distribution system and Daikin VRV® condenser unit.
3. The condenser shall be a direct expansion (DX), air-cooled heat pump, multi-zone air-conditioning system with variable speed inverter driven compressors using R-410A refrigerant.
4. The condensing unit may connect an indoor evaporator capacity up to 200% of the condensing unit capacity. All zones are each capable of operating separately with individual temperature control.
5. The Daikin condensing unit shall be interconnected to indoor unit models FXFQ, FXHQ, FXUQ, FXEQ, FXMQ, FXLQ, FXNQ, FXTQ, FXDQ, FXZQ, FXAQ and FXMQ MF as noted on contract drawings, and shall range in capacity from 7,500 Btu/h to 96,000 Btu/h in accordance with Daikin's engineering data book detailing each available indoor unit.
6. The indoor units shall be connected to the condensing unit utilizing Daikin's REFNET™ specified piping joints and headers to ensure correct refrigerant flow and balancing. T style joints are not acceptable for a variable refrigerant system.
7. Operation of the system shall permit either cooling or heating of all of the indoor units simultaneously. Each indoor unit or group of indoor units shall be able to provide set temperature independently via a local remote controller, an Intelligent Manager, an Intelligent Controller or a BMS interface.
8. The RXYQ\_TA condensing unit model numbers and the associated number of connectable indoor units per RXYQ\_TA condensing unit is indicated in the following table. Each indoor unit or group of indoor units shall be independently controlled.
9. Voltage Platform - Heat pump condensing units shall be available with a 208-230V/3ph/60Hz power supply.
10. Advanced Zoning - A single system shall provide for up to 64 zones.
11. Independent Control - Each indoor unit shall use a dedicated electronic expansion valve with 2000 positions for independent control.
12. VFD Inverter Control and Variable Refrigerant Temperature - Each condensing unit shall use high efficiency, variable speed all "inverter" compressor(s) coupled with inverter fan motors to optimize part load performance. The system capacity and refrigerant temperatures shall be modulated automatically to set suction and condensing pressures while varying the refrigerant volume for the needs of the cooling or heating loads. The control will be automatic and customizable depending on load and weather conditions.
13. Indoor shall use PID to control superheat to deliver a comfortable room temperature condition and optimize efficiency.
14. Configurator software - Each system shall be available with configurator software package to allow for remote configuration of operational settings and also for assessment of operational data and error codes.
15. If this software is not provided by an alternate manufacturer, for each individual outdoor unit the contractor shall do the settings manually and keep detailed records for future maintenance purposes.
16. Autocharging - Each system shall have a refrigerant auto-charging function.
17. Flexible Design –
18. Systems shall be capable of up to 540ft (165m) [623 ft. (190m) equivalent] of linear piping between the condensing unit and furthest located indoor unit.
19. Systems shall be capable of up to 3,280ft (1,000m) total "one-way" piping in the piping network.
20. Systems shall have a vertical (height) separation of up to 295ft between the condensing unit and the indoor units.
21. Systems shall be capable of up to 295ft (90m) from the first REFNET™ / branch point.

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22. The condensing unit shall have the ability to connect an indoor unit evaporator capacity of up to 200% of the condensing unit nominal capacity.
23. Systems shall be capable of 98ft (30m) vertical separation between indoor units.
24. Condensing units shall be supported with a fan motor ESP up to 0.32" WG as standard to allow connection of discharge ductwork and to prevent discharge air short circuiting.
25. Oil Return – Each system shall be furnished with a centrifugal oil separator and active oil recovery cycle.
26. Simple wiring – Systems shall use 16/18 AWG, 2 wire, stranded, non-shielded and non-polarized daisy chain control wiring.
27. Space saving – Each system shall have a condensing unit module footprint no larger than 48-7/8" x 30-3/16" (1694mm x 1242mm x 767mm).
28. Advanced diagnostics – Systems shall include a self-diagnostic, auto-check function to detect a malfunction and display the type and location.
29. Each condensing unit shall incorporate contacts for electrical demand shedding with optional 3 stage demand control with 12 customizable demand settings.
30. Advanced controls – Each system shall have at least one remote controller capable of controlling up to 16 indoor units.
31. Each system shall be capable of integrating with open protocol BACnet and LonWorks building management systems.
32. Low sound levels - Each system shall use indoor and condensing units with quiet operation as low as 27 dB(A).

#### 2.3 COOLING OPERATION:

1. The operating range in cooling will be 23°F db ~ 122°F db (-5°Cdb ~ 50°Cdb).
2. Cooling mode indoor room temperature range will be 57-77°F WB (13.8 - 25°CWB).
3. Cooling operation may be extended down to 10°F DB when the system is designed with the following limitations:
4. The system must be a single module outdoor unit: RXYQ72/96/120/144/168TA.
5. The smallest capacity indoor unit connected to the system must be 12,000 Btu/h.
6. The system must run continuously in cooling operation with a minimum of 1.5 tons of indoor units in operation.
7. Heating Operation:
8. The operating range in heating will be -4°F WB – 60°F WB.
9. Heating mode indoor room temperature range will be 59°FDB - 80°F DB.

#### 2.4 EQUIPMENT

##### A. Electrical:

1. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded, stranded 2 conductor cable.
2. The control wiring shall be a two-wire multiplex transmission system, making it possible to connect multiple indoor units to one condensing unit with one 2-cable wire, thus simplifying the wiring installation.
3. The control wiring maximum lengths shall be as shown below:

	CONDENSER TO INDOOR UNIT	CONDENSER TO CENTRAL CONTROLLER	INDOOR UNIT TO REMOTE CONTROL
CONTROL WIRING LENGTH	6,560 ft (2,000 m)	3,280 ft (1,000 m)	1,640 ft (500 m)
WIRE TYPE	16/18 AWG, 2 wire, non-polarity, non-shielded, stranded		

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B. Refrigerant Piping

1. The system shall be capable of refrigerant piping up to 540ft (165m) actual or 623ft (190m) equivalent from the condensing unit to the furthest indoor unit, a total combined liquid line length of 3,280ft (1,000m) of piping between the condensing and indoor units with 295ft (90m) maximum vertical difference, without any oil traps or additional components.
2. REFNET™ piping joints and headers shall be used to ensure proper refrigerant balance and flow for optimum system capacity and performance.
  - a. T style joints shall not be acceptable as this will negatively impact proper refrigerant balance and flow for optimum system capacity and performance.

C. PAINT/CORROSION RESISTANCE:

1. Paint and corrosion resistance shall be at a minimum per the table below:

COMPONENT	VRV IV		
	BASE MATERIAL	SURFACE TREATMENT	COATING THICKNESS
			External & Internal Surface
EXTERNAL PANEL BASE	Galvanized steel	POLYESTER	≥1.5 mils
EXTERNAL FRONT PANEL	Galvanized steel	POLYESTER	≥1.5 mils
PILLAR	Galvanized steel	POLYESTER	≥1.5 mils
COMPRESSOR COVER	ASTM material	Resin Paint	≥0.78 mils
FIN GUARD	Iron wire	Resin Paint	≥0.79 mils
FAN GUARD AND DRUM	Polypropylene	No treatment required	N/A
FAN	Acrylonitrile - glass	No treatment required	N/A
FAN MOTOR FRAME	Resin	No treatment required	N/A
FAN MOTOR SHAFT	Carbon steel	No treatment required	N/A
FAN MOTOR SUPPORT	Galvanized steel	POLYESTER	≥1.5 mils
HEAT EXCHANGERS (FIN ONLY)	Aluminum	Polymer Anti-corrosion surface treatment	Salt Spray 1000 hours, blister rating 10
ELECTRICAL PARTS BOX	Hot-dip zinc-coated steel	No treatment required	N/A
ELECTRICAL PARTS BOARD	Glass cloth / Glass nonwoven cloth material	Insulation Varnish	No specific thickness
SCREWS	Carbon steel wire rods	High corrosion resistance treatment	≥0.28 mils

2.5 OUTDOOR/CONDENSING UNIT

A. GENERAL:

1. The condensing unit is designed specifically for use with VRV series components.
2. The condensing unit shall be factory assembled in the USA and pre-wired with all necessary electronic and refrigerant controls.



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3. The refrigeration circuit of the condensing unit shall consist of Daikin inverter scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant accumulator.
  4. Liquid and suction lines must be individually insulated between the condensing and indoor units.
  5. The condensing unit can be wired and piped with access from the left, right, rear or bottom.
  6. The connection ratio of indoor units to condensing unit shall be permitted up to 200% of nominal capacity.
  7. Each condensing system shall be able to support the connection of up to 64 indoor units dependent on the model of the condensing unit.
  8. The sound pressure level standard shall be that value as listed in the Daikin engineering manual for the specified models at 3 feet from the front of the unit. The condensing unit shall be capable of operating automatically at further reduced noise during night time or via an external input.
  9. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.
  10. The unit shall incorporate an auto-charging feature to ensure optimum performance. Manual changing should be support with a minimum of 2 hours of system operation data to ensure correct operation.
  11. The condensing unit shall be modular in design and should allow for side-by-side installation with minimum spacing.
  12. 12. The following safety devices shall be included on the condensing unit; high pressure sensor and switch, low pressure switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
  13. 13. To ensure the liquid refrigerant does not flash when supplying to the various indoor units, the circuit shall be provided with a sub-cooling feature.
  14. 14. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation.
  15. 15. The condensing unit shall be capable of heating operation at 0°F (-18°C) dry bulb ambient temperature without additional low ambient controls or an auxiliary heat source.
- B. UNIT CABINET:
1. 1. The condensing unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed galvanized steel panels coated with a baked enamel finish.
- C. FAN:
2. 1. The condensing unit shall consist of one or more propeller type, direct-drive 350 or 750 W fan motors that have multiple speed operation via a DC (digitally commutating) inverter.
  3. The condensing unit fan motor shall have multiple speed operation of the DC (digitally commutating) inverter type, and be of high external static pressure and shall be factory set as standard at 0.12 in. WG. A field setting switch to a maximum 0.32 in. WG pressure is available to accommodate field applied duct for indoor mounting of condensing units.
  4. The fan shall be a vertical discharge configuration with a nominal airflow maximum range of 5,544 CFM to 22,283 CFM dependent on model specified.
  5. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.
  6. The fan motor shall be provided with a fan guard to prevent contact with moving parts.
- D. CONDENSER COIL:
1. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.
  2. The heat exchanger coil shall be of a waffle louver fin and rifled bore tube design to ensure high efficiency performance.
  3. The heat exchanger on the condensing units shall be manufactured from Hi-X seamless copper tube with N-shape internal grooves mechanically bonded on to aluminum fins to an e-Pass Design.

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4. The fins shall be coated with an anti-corrosion hydrophilic blue coating as standard from factory with a salt spray test rating of 1000hr per ASTM test standards.
5. The outdoor coil shall have three-circuit heat exchanger design eliminating the need for a drain pan heater. The lower part of the coil shall be used for inverter cooling and be on or off during heating operation enhancing the defrost operation.
  - a. An alternate manufacturer must provide a drain pan heater to enable adequate defrosting of the unit in defrost operation.
6. The condensing unit shall be factory equipped with condenser coil guards on all sides.

E. COMPRESSOR:

1. The Daikin inverter scroll compressors shall be variable speed (PVM inverter) controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit.
  - a. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read every 20 seconds and calculated. With each reading, the compressor capacity (INV frequency) shall be controlled to eliminate deviation from target value.
    - 1) Non –inverter-driven compressors, which may cause starting motor current to exceed the nominal motor current (RLA) and require larger wire sizing, shall not be allowed.
2. The inverter driven compressors in the condensing unit shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed scroll “G-type” or “J-type”.
3. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type.
  - a. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.
4. The capacity control range shall be as low as 10% to 100%.
5. The compressor’s motor shall have a cooling system using discharge gas, to avoid sudden changes in temperature resulting in significant stresses on winding and bearings.
6. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
7. Oil separators shall be standard with the equipment together with an intelligent oil management system.
8. The compressor shall be spring mounted to avoid the transmission of vibration eliminating the standard need for spring insulation.
9. In the event of compressor failure, the remaining compressors shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity. The microprocessor and associated controls shall be manually activated to specifically address this condition for single module and manifolded systems.
10. In the case of multiple condenser modules, conjoined operation hours of the compressors shall be balanced by means of the Duty Cycling Function, ensuring sequential starting of each module at each start/stop cycle, completion of oil return, completion of defrost or every 8 hours. When connected to a central control system sequential start is activated for all system on each DIII network.

2.6 BRANCH SELECTOR UNITS

A. GENERAL:

1. The branch selector boxes are designed specifically for use with VRV IV series heat recovery system components.
  - a. These selector boxes shall be factory assembled, wired, and piped.
  - b. These BSQ\_T / BS(4/6/8/10/12)Q54T branch controllers must be run tested at the factory.
  - c. These selector boxes must be mounted indoors.

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- d. When simultaneously heating and cooling, the units in heating mode shall energize their subcooling electronic expansion valve.

B. UNIT CABINET

1. These units shall have a galvanized steel plate casing.
  - a. Each cabinet shall house 3 electronic expansion valves for refrigerant control per branch.
  - b. The cabinet shall contain one subcooling heat exchanger per branch.
  - c. The unit shall have sound absorption thermal insulation material made of flame and heat resistant foamed polyethylene.
  - d. Nominal sound pressure levels must be measured and published on the submittals by the manufacturer. These sound levels must not exceed the values below.

C. REFRIGERANT VALVES:

1. The unit shall be furnished with 3 electronic expansion valves per branch to control the direction of refrigerant flow. The use of solenoid valves for changeover and pressure equalization shall not be acceptable due to refrigerant noise.
2. The refrigerant connections must be of the braze type.
3. In multi-port units, each port shall have its own electronic expansion valves. If common expansion/solenoid valves are used, redundancy must be provided.
4. Each circuit shall have at least one (36,000 Btu/h indoor unit or smaller for the BSQ36TVJ, 54,000 Btu/h indoor unit or smaller for the BS(4/6/8/10/12)Q54TVJ, 60,000 Btu/h indoor unit or smaller for the BSQ60TVJ and 96,000 Btu/h indoor unit or smaller for the BSQ96TVJ) branch selector box.
5. Multiple indoor units may be connected to a branch selector box with the use of a REFNET™ joint provided they are within the capacity range of the branch selector.

D. CONDENSATE REMOVAL:

1. The unit shall not require provisions for condensate removal. A safety device or secondary drain pan shall be installed by the mechanical contractor to comply with the applicable mechanical code, if an alternate manufacturer is selected.

E. ELECTRICAL:

1. The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
2. The unit shall be capable of operation within the limits of 187 volts to 255 volts.
3. The minimum circuit amps (MCA) shall be 0.1 and the maximum overcurrent protection amps (MOP) shall be 15.
4. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded 2 conductor cable.

2.7 ROUND FLOW CEILING CASSETTE INDOOR UNIT

- A. General: Daikin indoor unit model FXFQ\_T shall be a round flow ceiling cassette fan coil unit, operable with R-410A refrigerant, equipped with an electronic expansion valve, direct drive DC (ECM) type fan, for installation into the ceiling cavity equipped with an air panel grill. It shall be available in capacities from 7,500 Btu/h to 48,000 Btu/h. It shall be a round flow air distribution type, fresh white, impact resistant decoration panel, or optional self-cleaning filter panel. The supply air is distributed via four individually motorized louvers. To save energy and optimize occupancy comfort, the indoor unit shall be equipped with built in occupancy sensor and surface temperature sensor. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with Daikin remote control BRC1E72, BRC1E73, BRC2A71 and BRC1E52B7. The indoor units sound pressure shall range from 30 dB(A) to 45 dB(A) at High speed measured at 5 feet below the unit.
- B. Indoor Unit:

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1. The Daikin indoor unit FXFQ\_T shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
  2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
  3. Both refrigerant lines shall be insulated from the outdoor unit.
  4. The round flow supply air flow can be field modified to 23 different airflow patterns to accommodate various installation configurations including corner installations.
  5. Return air shall be through the concentric panel, which includes a resin net, mold resistant, antibacterial filter.
  6. The indoor units shall be equipped with a condensate pan with antibacterial treatment and condensate pump. The condensate pump provides up to 33-1/2" of lift from bottom of unit to top of drain piping and has a built in safety shutoff and alarm.
  7. The indoor units shall be equipped with a return air thermistor.
  8. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
  9. The voltage range will be 253 volts maximum and 187 volts minimum.
  10. To save energy and optimize occupancy comfort, the indoor unit shall be equipped with built in occupancy sensor and surface temperature sensor.
  11. Supplied air shall be directed automatically by four individually controlled louvers.
- C. Unit Cabinet:
1. The cabinet shall be space saving and shall be located into the ceiling.
  2. Four auto-adjusted louvers shall be available to choose, which include standard, draft prevention and ceiling stain prevention.
  3. The airflow of the unit shall have the ability to shut down outlets with multiple patterns allowing for simpler installation in irregular spaces.
  4. Fresh air intake shall be possible by way of Daikin's optional fresh air intake kit.
  5. A branch duct knockout shall exist for branch ducting of supply air.
  6. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
- D. Fan:
1. The fan shall be direct-drive DC (ECM) type fan, statically and dynamically balanced impeller with three fan speeds available.
  2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range from 0.08 to 0.16 HP.
  3. The airflow rate shall be available in three manual settings.
  4. The DC fan shall be able to automatically adjust the fan speed in 5 speeds based on the space load.
  5. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings to allow operation with the high efficiency air filter options.
  6. The fan motor shall be thermally protected.
- E. Filter:
1. The return air shall be filtered by means of a washable long-life filter with mildew proof resin and antibacterial treatment.
- F. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
  2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
  3. The coil shall be a 2, or 3-row cross fin copper evaporator coil with up to 21 FPI design completely factory tested.
  4. The refrigerant connections shall be flare connections and the condensate will be 1 -1/4 inch outside diameter PVC.

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5. A condensate pan with antibacterial treatment shall be located under the coil.
  6. A thermistor will be located on the liquid and gas line.
- G. Electrical:
1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
  2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
  3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.
- H. Control:
1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
  2. The unit shall be compatible with interfacing with a BMS system via future BACnet gateway.
  3. The unit shall be compatible with a future Daikin Intelligent Touch Manager advanced multi-zone controller.
- I. Accessories:
4. Air intake kit

## 2.8 2x2 CASSETTE UNIT

- B. Indoor Unit:
1. The Daikin indoor unit FXZQ-TAVJU shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
  2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
  3. Both refrigerant lines shall be fully insulated from the outdoor unit or nearest branch connection into the refrigerant network.
  4. The 4-way supply air flow can be field modified to 3-way and 2-way airflow to accommodate various installation configurations including corner installations.
  5. Return air shall be through the concentric panel, which includes a resin net mold resistant filter.
  6. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 24-13/16" of lift, measured from the drain outlet, and has a built in safety shutoff and alarm.
  7. The indoor units shall be equipped with a return air thermistor.
  8. The indoor unit will be powered with 208~230V/1-phase/60Hz.
  9. The voltage range will be 253 volts maximum and 187 volts minimum.
- C. Unit Cabinet:
1. The cabinet shall be space saving and shall be located into the ceiling.
  2. Three auto-swing positions shall be available to choose from via field setting.
  3. The airflow of the unit shall have the ability to shut down one or two sides allowing for simpler corner installation.
  4. Fresh air intake shall be possible by way of direct duct installation to the side of the indoor unit cabinet.
  5. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
- D. Decoration Panel:
1. The FXZQ-TAVJU series shall be compatible with three optional decoration panels:
  2. VISTA Decoration panel – white (BYFQ60C3W1W).

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- a. The decoration panel shall be a four-way air distribution type and constructed of impact resistant polymer.
  - b. The decoration panel dimensions shall measure 24-7/16" x 24-7/16" and shall fit into a standard 2x2 ceiling grid with no overlap of adjacent tiles.
  - c. The four air discharge outlet louvers shall be independently motorized and controllable. Each louver shall have a visual indicator to easily identify the louver and simplify the airflow configuration.
  - d. The louver outlets shall be capable of closure to allow for 3-way and 2-way air distribution.
  - e. The decoration panel shall be a low profile design, extending 5/16" below the ceiling.
  - f. The decoration panel color shall be fresh white (Munsell N9.5).
- E. Fan:
  1. The fan shall be driven by a direct-drive DC motor with statically and dynamically balanced impeller and shall have three user-selectable speeds available: high, medium, and low.
  2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output of 50W.
  3. The airflow rate shall be available in high, medium, and low settings.
  4. When FXZQ-TAVJU is connected with either the BRC1E73 Navigation Remote Controller or the DCM601A71 I-Touch Manager, the Auto fan mode shall be selectable.
- F. Filter:
  1. The return air shall be filtered by means of a washable long-life filter with mildew proof resin.
- G. Coil:
  1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
  2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
  3. The coil shall be a 2-row cross fin copper evaporator coil with 22 FPI design completely factory tested.
  4. The refrigerant connections shall be flare connections and the condensate will be 1 -1/32 inch outside diameter PVC.
  5. A condensate pan shall be located under the coil.
  6. A condensate pump with a 24-13/16" lift, measured from the drain outlet, shall be located below the coil in the condensate pan with a built in safety alarm.
  7. A thermistor will be located on the liquid and gas line.
- H. Electrical:
  1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
  2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
  3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.
- I. Control:
  1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
  2. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.
- J. Accessories:
  1. VISTA Decoration panel – white (BYFQ60C3W1W)
  2. Direct fresh air intake kit (KDDQ44XA60).

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3. Wired remote controller (BRC1E73)
4. Adaptor for wiring (KRP1C75)
5. Wiring adaptor for electrical appendices (KRP4A74)

## 2.8 CONCEALED CEILING DUCTED UNIT

- A. General: Daikin indoor unit FXMQ shall be a built-in ceiling concealed fan coil unit, operable with refrigerant R-410A or R32, equipped with an electronic expansion valve, direct-drive DC (ECM) type fan with auto CFM adjustment at commissioning, for installation into the ceiling cavity. It is constructed of a galvanized steel casing. It shall be connected to outdoor unit model REYQ heat recovery model. It shall be a horizontal discharge air with horizontal return air configuration. All models feature a low height cabinet making them applicable to ceiling pockets that tend to be shallow. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with Daikin remote control BRC1E72, BRC1E73 and BRC2A71. Included as standard equipment, a condensate drain pan and drain pump kit that pumps to 18-3/8" from the drain pipe opening. The indoor units sound pressure shall range from 29 dB(A) to 43 dB(A) at low speed measured 5 feet below the ducted unit.
- B. Performance: Each unit's performance is based on nominal operating conditions as indicated on equipment schedules.
- C. Indoor Unit:
  1. The Daikin indoor unit FXMQ shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall be equipment with automatically adjusting external static pressure logic that is selectable during com-

Model Number	Cooling (Indoor 80°F DB / 67°F WB, Outdoor 95°F DB, 25 ft pipe length)	Heating (Indoor 47°F DB / 43°F WB, Outdoor 70°F DB, 25 ft pipe length)
FXMQ07PAVJU	7,500	8,500
FXMQ09PAVJU	9,500	10,500
FXMQ12PAVJU	12,000	13,500
FXMQ15PAVJU	15,000	16,500
FXMQ18PAVJU	18,000	20,000
FXMQ24PAVJU	24,000	27,000
FXMQ30PAVJU	30,000	34,000
FXMQ36PAVJU	36,000	40,000
FXMQ48PAVJU	48,000	54,000
FXMQ54PAVJU	54,000	60,000

- missioning. This adjusts the airflow based on the installed external static pressure.
2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
3. Both refrigerant lines shall be insulated from the outdoor unit.
4. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 18-3/8" of lift from the center of the drain outlet and has a built in safety shutoff and alarm.
5. The indoor units shall be equipped with a return air thermistor.

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6. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
7. The voltage range will be 253 volts maximum and 187 volts minimum.
- D. Unit Cabinet:
  1. The cabinet shall be located into the ceiling and ducted to the supply and return openings.
  2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
- E. Fan:
  1. The fan shall be direct-drive DC (ECM) type fan, statically and dynamically balanced impeller with three fan speeds available.
  2. The unit shall be equipment with automatically adjusting external static pressure logic selectable during commissioning.
  3. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range of 0.12 to 0.47 HP respectively.
  4. The airflow rate shall be available in three settings.
  5. The fan motor shall be thermally protected.
  6. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.
  7. Fan motor external static pressure range for nominal airflow:

Model Number	Fan ESP (in. WG)
FXMQ07PAVJU	0.40 – 0.12
FXMQ09PAVJU	0.40 – 0.12
FXMQ12PAVJU	0.40 – 0.12
FXMQ15PAVJU	0.80 – 0.20
FXMQ18PAVJU	0.80 – 0.20
FXMQ24PAVJU	0.80 – 0.20
FXMQ30PAVJU	0.80 – 0.20
FXMQ36PAVJU	0.80 – 0.20
FXMQ48PAVJU	0.80 – 0.20
FXMQ54PAVJU	0.56 – 0.20

- F. Coil:
  1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
  2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
  3. The coil shall be a 3 row cross fin copper evaporator coil with 15 fpi design completely factory tested.
  4. The refrigerant connections shall be flare connections and the condensate will be 1-1/4" outside diameter PVC.
  5. A condensate pan shall be located under the coil.
  6. A condensate pump with an 18-3/8" lift shall be located below the coil in the condensate pan with a built in safety alarm.
  7. A thermistor will be located on the liquid and gas line.
- G. Electrical:
  1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
  2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
  3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.
- H. Control:



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1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
  2. The unit shall be compatible with interfacing with a BMS system via BACnet gateways.
  3. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.
- I. Accessories:
1. Remote "in-room" sensor kit KRCS01-4B.
    - i. The Daikin wall mounted, hard wired remote sensor kit for when a NAV controller is not used or when the NAV controller is not located in the space that is being controlled. The sensor for detecting the temperature can be placed away from the indoor unit (branch wiring is included in the kit).
  2. MERV 13 Filter kit. Can be configured for right or left access. Filters replaceable without tools.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Equipment Mounting:
1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s).
- D. Install all controls and control wiring noted above and required for a complete fully correctly functioning VRF system. This to include time required for programming of the system to provide a system manufacturer sequence of operation to be submitted and approved by Engineer.

#### 3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized and factory-employed 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 and factory-employed service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

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3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

### 3.3 STARTUP SERVICE

A. Engage a factory-authorized and factory-employed service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Manufacturer shall provide the services of a Factory Authorized Service Engineer to provide complete start-up supervision. The Manufacturer's Representative shall provide a minimum of 16-hours of BACnet integration assistance with the owner's building automation contractor.

### 3.4 DEMONSTRATION

A. Engage a factory-authorized and factory-employed service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

**END OF SECTION**

SECTION 238228 – RADIANT CEILING PANELS

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 electric radiant ceiling panels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and 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. Indicate location and size of each field connection.
  - 4. Indicate location and arrangement of integral controls and other accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. 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. Structural members to which radiant panels will be attached.
  - 2. Method of attaching radiant panels to building structure.
  - 3. Penetrations of fire-rated wall and floor assemblies.
- B. Field quality-control reports.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

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1.6 QUALITY ASSURANCE

- A. Heating output of panel is in accordance with EN 14037.
- B. Acoustic performance is in accordance with DIN EN ISO 354.

PART 2 - PRODUCTS

2.1 ELECTRIC RADIANT CEILING PANELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Berko
  - 2. Qmark
  - 3. Ritting
- B. General: Description: Sheet-metal-enclosed panel with heating element suitable for lay-in installation flush with T-bar ceiling grid. Comply with UL 2021.
  - 1. Panel: Minimum 0.0276-inch-thick, galvanized sheet steel back panel riveted to minimum 0.0396-inch-thick, galvanized sheet steel front panel with fused-on crystalline surface.
  - 2. Heating Element: Powdered graphite sandwiched between sheets of electric insulation.
  - 3. Heating Element: Insulated resistive wires.
  - 4. Electrical Connections: Nonheating, high-temperature, insulated-copper leads, factory connected to heating element.
  - 5. Mounting: T-bar or recessed mounting frame as required.
  - 6. Exposed-Side Panel Finish: Apply silk-screened finish to match appearance of Architect-selected acoustical ceiling tiles.
  - 7. Wall Thermostat: Bimetal, sensing elements calibrated from 55 to 90 deg F with contacts suitable for line-voltage circuit, and manually operated on-off switch with contactors, relays, and control transformers.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive radiant panels 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. Install units level and plumb.
- B. Install expansion compensation hoses.
- C. Install piping covers.

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3.3 CONNECTIONS

- A. Install piping adjacent to radiant panels to allow service and maintenance.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

**END OF SECTION**

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SECTION 238239 – UNIT HEATERS

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 heaters with propeller fans and electric-resistance heating coils.
  - 2. Cabinet unit heaters with centrifugal fans and electric-resistance heating coils.
  - 3. Propeller unit heaters with electric-resistance coils.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. CWP: Cold working pressure.
- C. PTFE: Polytetrafluoroethylene plastic.
- D. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- 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. Plans, elevations, sections, and details.
  - 2. Location and size of each field connection.
  - 3. Details of anchorages and attachments to structure and to supported equipment.
  - 4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
  - 5. Location and arrangement of piping valves and specialties.
  - 6. Location and arrangement of integral controls.
  - 7. Wiring Diagrams: Power, signal, and control wiring.
- C. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.

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- D. Samples for Verification: Finish colors for each type of cabinet unit heater and wall and ceiling heaters indicated with factory-applied color finishes.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For cabinet unit heaters 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

## PART 2 - PRODUCTS

### 2.1 WALL HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Berko Electric Heating; a division of Marley Engineered Products.
  - 2. Chromalox, Inc.; a division of Emerson Electric Company.
  - 3. Marley Electric Heating; a division of Marley Engineered Products.
  - 4. QMark Electric Heating; a division of Marley Engineered Products.
- B. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.
- C. Cabinet:
  - 1. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners, and tamperproof thermostat.
  - 2. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
  - 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.
- E. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection. Provide integral circuit breaker for overcurrent protection.

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- F. Fan: Aluminum propeller directly connected to motor.
  - 1. Motor: Permanently lubricated, multispeed. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
- G. Controls: Unit-mounted tamper resistant thermostat.
- H. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

## 2.2 ELECTRIC CABINET UNIT HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Sigma
  - 2. Berko
  - 3. Vulcan
- B. Description: A factory-assembled and -tested unit complying with ARI 440.
  - 1. Comply with UL 2021.
- C. Coil Section Insulation: ASTM C 1071; surfaces exposed to airstream shall be aluminum-foil facing to prevent erosion of glass fibers.
  - 1. Thickness: 1 inch.
  - 2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F mean temperature.
  - 3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
  - 4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.
  - 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Cabinet: Steel with baked-enamel finish with manufacturer's custom paint, in color selected by Architect.
  - 1. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch- thick, galvanized, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
  - 2. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0528-inch- thick, galvanized, sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
  - 3. Recessing Flanges: Steel, finished to match cabinet.
  - 4. Control Access Door: Key operated.
  - 5. Base: Minimum 0.0528-inch- thick steel, finished to match cabinet, 6 inches high with leveling bolts.
  - 6. Extended Piping Compartment: 8-inch- wide piping end pocket.
  - 7. False Back: Minimum 0.0428-inch- thick steel, finished to match cabinet.
- E. Filters: One inch throwaway.
- F. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, mounted in ceramic inserts in galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.



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- G. Fan and Motor Board: Removable.
  - 1. Fan: Forward curved, high static, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
  - 2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  - 3. Wiring Terminations: Connect motor to chassis wiring with plug connection.
- H. Control devices and operational sequences are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls." Refer to these sections for additional requirements for unit manufacturer provided controls and ATC contractor provided controls.

## 2.3 PROPELLER UNIT HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Berko
  - 2. Reznor.
  - 3. Sigma
- B. Description: An assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.
- C. Comply with UL 2021.
- D. Comply with UL 823.
- E. Cabinet: Removable panels for maintenance access to controls.
- F. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.
- G. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- H. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.
- I. General Coil Requirements: Test and rate hot-water propeller unit heater coils according to ASHRAE 33.
- A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, mounted in ceramic inserts in galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.
- B. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.
- C. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
  - 1. Motor Type: Permanently lubricated.

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- D. Control devices and operational sequences are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls." Refer to these sections for additional requirements for unit manufacturer provided controls and ATC contractor provided controls.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Division 07 Section "Joint Sealants."
- B. Install cabinet unit heaters to comply with NFPA 90A.
- C. Install propeller unit heaters level and plumb.
- D. Suspend cabinet unit heaters from structure with elastomeric hangers. Vibration isolators are specified in Division 23 Section "Vibration and Controls for HVAC Piping and Equipment."
- E. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers with vertical-limit stop. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Division 23 Section "Vibration and Controls for HVAC Piping and Equipment."
- F. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- G. Install new filters in each unit within two weeks of Substantial Completion.

#### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections.
- B. Comply with safety requirements in UL 1995.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

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- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 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 motor rotation and unit operation.
  - 2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
  - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

### 3.5 ADJUSTING

- A. Adjust initial temperature set points.
- B. 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.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters. Refer to Division 01 Section "Demonstration and Training."

**END OF SECTION**

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SECTION 2600000 – SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions Specification Sections, apply to this Section.
- B. The requirements of all other sections of Division 26, 27 & 28 apply to this section.

1.2 WARRANTY FOR PROJECT

- A. The Contractor shall provide the Owner with a (2) two-year warranty on all materials, labor and systems from the date of Substantial Completion. The date of Substantial completion will be as set in a letter issued by the Architect.

1.3 DEFINITIONS

- A. For a complete list of definitions for this contract refer to the Division 1 specifications.
- B. Provide: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.
- C. Install: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.
- D. Rewire: Means to intercept wiring, splice and extend to new circuit location. Existing wiring to device can remain.

1.4 SCOPE OF WORK

- A. Refer to drawing E001 for a delineation of work between the various contractors, vendors and owner for the electrical systems.
- B. Refer to drawing A001 for a listing of the various contractors and vendors on this project, including their respective scope of work. Electrical contractor is required to closely coordinate with all of the contractors and vendors due to the support nature of the electrical work with conduits, wiring, backboxes and power.
- C. Work Included: It is the intent of these specifications and the accompanying drawings that the Contractor shall, unless otherwise specified herein, furnish all labor, materials, tools, and equipment necessary, together with the necessary accessories to constitute a satisfactory and complete installation, to complete the installation of the electrical work, as indicated on the drawings and described hereinafter. The Contractor shall properly install, equip, adjust and put in perfect condition, the respective portions of the work specified, and to so interconnect the various items or sections of the work to form a complete and properly operating whole. The work shall consist of, but shall not necessarily be limited to the following for the New Elementary School in the Tredyffrin/Easttown School District (all scope listed below is base bid unless otherwise noted):

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1. Construction Phasing and Sequencing:
  - a. Working hours and dates: Refer to the Division 0 and 1 specifications and the contract drawings for all details and requirements.
  - b. Refer to drawing A005 for additional phasing requirements, site utilization and locations of construction trailers.
  - c. Phase A:
    - 1) The electrical service will be relocated, including the PECO transformer location. New primary and secondary ductbanks and cabling is required.
    - 2) During the power outage period for the electrical service, the electrical contractor shall provide a temporary 100kW diesel generator and temporarily hook it up to the (2) MDP switchboards in the main electrical room. Coordinate with the District to lockout the air conditioning on the existing rooftop units. Generator shall run 24x7 to provide temporary power to the building, lighting and site lighting. Electrical contractor is responsible to re-fill the diesel tank of the generator on a daily basis. Shut-down of the generator will be allowed when the new service entrance cables are terminated on the MDPs; generator shall continue to serve one of the MDPs while the other MDP service cables are being terminated.
    - 3) Coordinate with PECO to accommodate either the relocation of their transformer or a new transformer on the contractor provided new concrete vault.
    - 4) Underground conduits and site work to accommodate the new foundations and underslab prep work.
  - d. Phase B: Main building construction.
2. For detailed scope of work for each electrical system, refer to the respective Division 26, 27 and 28 specification sections.
3. Provide and install temporary electrical power to the building, for construction activities in accordance with Division 0 & 1 specifications and/or as required for continuing construction.
4. Provide and install temporary electrical service to all the construction trailers on the site. Refer to Division 0 & 1 specifications for full information and requirements.
5. Provide and install wiring and conduits for lighting and power.
6. Provide and install lighting equipment and controls, including digital controllers and programming of the controllers and wall switches.
7. Provide new wall mounted 0-10V lighting dimmer switches and associated low-voltage and branch circuit wiring to each associated fixture.
8. Provide and install new LED site lighting, including conduits, wiring, controls, concrete foundations, poles and handholes.
9. Provide and install new emergency lighting, including UL924 relays.
10. Provide and install a standalone stage theatrical lighting system, including all touch screens, LED lights, control wiring, battens/rigging and the like for a fully functional system.
11. Provide and install new panelboards and feeders.
12. Provide and install new ultra-high efficiency dry-type transformers.
13. Provide and install new wiring devices and backboxes, including source and circuit labeling.
14. Provide and install new floor boxes and poke-thru assemblies.
15. Provide and install relocated PECO service, including the transformer vault, grounding, all excavation for the MV and LV conduits and cables and conduits. Install new provisions for a separately mounted PECO meter next to the transformer.
16. Provide and install new medium voltage cabling, including terminations and grounding.
17. Provide and install new service conduits and cables and convert the existing CT cabinet into a junction box. Coordination with PECO will be required for removal of the existing CTs.

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18. Relocate the existing diesel generator with sub-base tank and sound attenuating housing. Contractor is required to contract with the original manufacturer to add in a second breaker for the separate life safety feed. Contractor is responsible for filling the diesel tank to full, including topping off the tank after all testing and startup work.
19. Provide and install new automatic transfer switches and generator quick-connect / docking station equipment.
20. Provide a new short circuit, coordination and arc flash study and label all new electrical and existing equipment with arc flash labels.
21. Provide and install fused or non-fused disconnect switches, or circuit breakers at the various pieces of equipment as required by the N.E.C.Code.
22. Provide and install new low-voltage wiring, conduits and backboxes for low-voltage electrical systems.
23. Provide and install a new voice evacuation style Fire Alarm system with Ethernet/cellular digital communicators and all new wiring and devices.
24. Provide and install new site communications, including conduits, handholes and fiber optic cabling and CAT6E cabling.
25. Provide and install new structured cabling systems including new racks, patch panels, CAT6 and 6A cabling, fiber optic cabling, jacks and testing for a complete and fully functional system. Electronic equipment (cameras, switches and wireless access points) will be provided by the Owner and/or their Vendors.
26. Provide and install site fiber optic cabling and conduits to pole-mounted cabinets.
27. Provide and install plenum rated wiring back to the MDF for the security systems. Wiring shall be tied into each exterior door's contacts and homerun to the MDF room. Wiring shall also be provided for the proposed keypad location(s). Actual security system equipment and final wiring terminations at the head end will be by the Owner's security vendor.
28. Provide and install a new fully functional Public Address system, including IP phones and speakers throughout the building. All classroom, SGR and similar academic spaces shall have homerun wiring to the headend PA system rack in the MDF room.
29. Provide and install a new wireless clock system, including head-end master clock, clocks and 120V power for all clocks. Interface with the PA system for tone scheduling.
30. Refer to the attached Appendix A for the audio/visual systems scope of work.
31. Provide and install new grounding systems per NEC.
32. Adjust connections to electrical motors to ensure proper rotation.
33. Provide and install wiring and final connections to all equipment in Architectural Specifications requiring electrical service.
34. Provide and install wiring and final connections to all equipment in Mechanical, Plumbing and Fire Protection specifications and drawings requiring electrical service.
35. Testing and balancing of Electrical system.
36. All necessary rigging.
37. Removal of trash and general clean-up.
38. All necessary permits, approvals, fees, etc.
39. Instructions and training to the Owner.
40. Cutting, patching and clean-up.
41. The contractor shall employ the services of the local Underwriters' Inspection Agency and pay for all associated fees.
42. Alternate bid:
  - a. Alternate #8: Provide and install new 500kW diesel generator in lieu of the optional standby generator quick-connect provided under the base bid. This shall include concrete foundation, sub-base tank, sound attenuating housing and all conduit and wiring for a complete and fully functional system. Contractor is responsible to fill the diesel tank to full and top off the tank to full after all testing and startup work.

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- D. It will be the responsibility of the Contractor to examine all Drawings (Architectural, Civil, Structural, Mechanical, Plumbing, Electrical, Fire Protection, etc.) to determine the full extent of the work. Electrical work noted on any drawing in the contract set shall be the responsibility of the Electrical Contractor. All field measurements and verifications of conditions and materials will be the obligation of the Contractor. The submission of a Proposal by the Contractor will be considered an indication that all work has been included in the Proposal. It will also be considered an indication that a thorough review of conditions, materials, and all related specifications have been investigated by the Contractor, and the results of such investigations have been included in the Contractor's Proposal.
- E. Coordination Between Mechanical and Electrical Contractors:
1. The Electrical Contractor shall:
    - a. Receive and set the motor starters as provide by the Mechanical and Plumbing Contractors.
    - b. Provide power wiring, including final connection of same, from source to starters/VFDs and to the motors.
    - c. Receive and install the wall-mounted electrical control devices, thermal switches, control power transformers, etc., and provide all wiring for same.
    - d. Provide all fused or unfused disconnect switches and circuit breakers not supplied as part of the HVAC system and as required by the National Electrical Code, or as shown on the drawings, or as specified.
    - e. Adjust connections to electrical motors to insure proper rotation.
    - f. Provide duct detectors and air sampling tubes to the MC for installation in the ductwork. EC shall wire and program the duct detectors and remote test stations into the fire alarm system. MC shall wire the duct detector shut-down into the BAS system or the respective HVAC unit.
    - g. Provide 120V to the MC provide duct smoke dampers. Control of the smoke dampers shall be via the EC provided fire alarm system.
    - h. For 24V hard-wired sensor plumbing fixtures, the PC shall provide the 120V-24V transformers for the EC to install and wire at 120V. The PC shall be responsible for all low-voltage 24V wiring from the transformers to each sensor plumbing fixture, including ½" conduits, boxes and wiring.
  2. The Mechanical Contractor will:
    - a. Furnish and set all motors for mechanical equipment.
    - b. Furnish all motor starters, starter/disconnects, HVAC unit mounted disconnects, contactors, pushbuttons and switches for local and remote control of all HVAC equipment and turn over to the Electrical Contractor for installation.
    - c. Provide pre-wired control panels, including relays, switches, pilot lights, etc., all as shown and/or specified, complete with wiring to numbered terminal strips.
    - d. Furnish and install duct and pipe-mounted control devices, such as freezestats, aquastats, flow switches, etc.
    - e. Furnish wiring diagrams for the systems, in sufficient time to allow roughing-in of conduit in accordance with the proposed work schedule.
    - f. For HVAC controls, the MC or their controls sub-contractor is responsible to provide all control wiring including 120V controls, 120V power to controls cabinets, 120V power and 120/24V control power transformers as required for a complete and fully functional system. EC will only install the main power feeds to each piece of HVAC equipment.
    - g. Provide all data CAT6 cabling, as required, for the HVAC controls equipment and systems from the nearest IDF or MDF closet. MC shall hire the EC's low-voltage sub-contractor to

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- perform this work for consistency.
  - h. Receive duct detectors and air sampling tubes from the EC and install in the ductwork. MC shall provide and install all shut-down and system activation wiring from the smoke detectors to the respective units.
3. The Plumbing Contractor will:
- a. Furnish and set all motors for plumbing equipment.
  - b. Coordinate locations of all equipment with both the Mechanical and Electrical Contractors.
  - c. Provide the Electrical Contractor with information and instructions for connection of electrical service to water coolers, domestic hot water heater, etc.
  - d. For 24V hard-wired sensor plumbing fixtures, the PC shall provide the 120V-24V transformers for the EC to install and wire at 120V. The PC shall be responsible for all low-voltage 24V wiring from the transformers to each sensor plumbing fixture, including ½” conduits, boxes and wiring.
4. The Electrical Contractor shall examine the drawings and read the specifications for the general, mechanical, plumbing and fire protection trades, and shall note all motor-driven equipment, starters and control apparatus noted, shown or specified herein.
- F. Architectural Equipment Wiring and Connections:
- 1. All equipment for will be furnished and set by the Equipment Contractor.
  - 2. The Electrical Contractor shall run all electrical conduit and wiring to each piece of equipment requiring electrical service and shall make all final connections to the equipment.
  - 3. The equipment and required wiring connections are shown on the drawings or in wiring schedules.
  - 4. This Electrical Contractor shall furnish disconnect switches at the various pieces of equipment as required by the NEC.

#### 1.5 WARRANTY

- A. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion of each Phase. It will not make any difference when equipment is ordered, delivered or installed, warranties will commence after the Architect issues his letter of “Substantial Completion.”
- B. All equipment is to include factory start-up unless the Contractor receives written permission, from the School District, for Contractor start-up. Copies of the start-up report must be included with the Request for Final Payment, otherwise final payment will be withheld until the factory reports are submitted.
- C. All equipment furnished for this School shall include a (2) two-year warranty on parts and labor. This warranty shall supersede all notations in all the other Division 26, 27 and 28 specification sections, except for specifications with a longer warranty period shall prevail.

PART 2 - PRODUCTS (Not applicable).

PART 3 - EXECUTION (Not applicable).

END OF SECTION 260000



## **APPENDIX A**

### **AUDIO-VISUAL SYSTEM INTEGRATION REQUIREMENTS**

#### **PURPOSE**

This document is to provide guidance regarding standards for the design and installation of AV systems for the TE New Elementary School project. This document, along with industry standards, are to be followed by the contractors.

Refer to the Division 0 and 1 specifications and also E001 and A001 drawings for the delineation of work on the project between contractors, vendors and owner.

Design team and construction contractors shall meet all requirements as specified in this document, and refer to this document for all design. All design aspects are required to be approved by Tredyffrin/Easttown School District (TESD or Owner) Technology Department prior to installation.

#### **GENERAL**

##### **1. Systems Integration and Programming:**

- A/V systems on this project shall be as specified herein and as shown on the drawings
- Integrator to provide shop drawings detailing wiring for each location prior to installation and get approval from TSED.
- The contractor shall provide all programming as required for a complete and fully functional A/V system for each room indicated to receive a new A/V System. Programming of the system controller functions are to be completed by the A/V installer as per the TSED's instructions per outcome of meetings with TSED to discuss system flow.
- The new A/V System shall be integrated with the headend PA system rack to allow for emergency all-calls over the system. Programming of the system controller functions are to be completed by the A/V installer as per the TSED's instructions per outcome of meetings with TSED to discuss system flow.
- The contractor shall include a minimum of 3 meetings with the TSED to review the proposed setup and programming of the equipment prior to installation.
- TSED will provide IP addresses for each piece of equipment prior to installation as required.
- Final copies of all compiled/uncompiled programming are to be provided to TSED upon project completion.

##### **2. Installation**

- AV contractor, who will be providing listed equipment should build racks and touch screens at the contractor's location of business and deliver/installed when permitted by the electrical contractor.
- All A/V equipment, cables and components shall be provided by the contractor for a complete and fully operational A/V system for each space, including the mounting hardware and devices and all system programming.
- Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.
- Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system

wiring diagrams. Wiring identification shall be included on each end of the cable and any junction boxes or equipment in between.

### **3. Adjustments**

- On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions. Provide site visit reports from the representative to confirm work has been completed and there are no open issues.
- Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the systems to suit actual occupied conditions. Provide up to (2) two, 4-hour visits to Project during other-than-normal occupancy hours for this purpose.

### **4. Inspections**

- Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
- A/V systems will be considered defective if they do not pass tests and inspections. Contractor will be required to perform corrective measures and re-test the systems to the satisfaction of TESD.
- Follow up training and demonstration shall occur on (1) day. Other staff and instructors will attend this follow up training and demonstration, in addition to TESD's technical staff.

### **5. Demonstrations and Training**

- The contractor shall include on-site demonstration to TESD of each of the systems for each of the rooms for the purposes of training and to verify with TESD correct implementation of the system operation. Time shall be included for correction of items and re-demonstration to TESD.
- Training and demonstration shall occur during (2) separate 3 hour periods, not necessarily on consecutive days. Coordinate and schedule the meetings a minimum of 14 days in advance with TESD.

## **SUBMITTALS**

1. **Product Data:** For each type of product indicated and installed including model, serial number and location installed.
2. **Shop Drawings:** For A/V systems. Include plans, elevations, sections, details, and attachments to other work.
  - Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location and size of each field connection.
  - Include scaled drawings for racks that detail built-in equipment.
  - **As-Built Wiring Diagrams:** For power, signal, and control wiring.
    - Identify terminals to facilitate installation, operation, and maintenance.
    - Single-line diagram showing interconnection of components.
    - Cabling diagram showing cable routing.
  - **Coordination Drawings:** As appropriate, provide reflected ceiling and wall mounted items and plans, drawn to scale, on which pole-mounted items including, speakers, cameras and wireless access points are shown and coordinated with each other, using input from Installers of the items involved.
  - **Operation and Maintenance Data:** For A/V systems to include in operation and maintenance manuals.
  - **For microprocessor-switched equipment:**
    - A record of TESD's equipment-programming option decisions.
    - As-built single-line diagrams of the systems, including IP addresses.

## **QUALITY ASSURANCE**

1. **Installer Qualifications:** Manufacturer's authorized representative who is trained and approved for installation of units required for this project.
2. **Certifications Required:**
  - Crestron, CTS-D, CTS-I
  - Authorized dealers for Crestron A+ for special education pricing of equipment specified by owner and supplied by AV contractor
  - Newtek Authorized Dealer (NDI certified)
  - QSC Q-Sys Certified
3. Coordinate layout and installation of wall and pole mounted assemblies.

## **MANUFACTURERS**

1. **Manufacturers:** Subject to compliance with requirements, provide core products as listed by Smart, Crestron, Epson, Da-Lite, Shure & QSC using education reduced price programs. Bid should reflect special pricing discounts to TESD.

## **PER SPACE A/V SYSTEMS SCOPE/DRAWINGS, BILL OF MATERIALS**

1. The following bill of material listings are provided as the basis of design. The bill of materials shall not be considered complete, as ancillary devices, cables, connectors and jacks shall be provided for a complete

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and fully operational system. Refer also to the AV drawings for the scope and locations of the A/V devices.

***Please Note:***

- ***Locations, elevations, and mounting details of all below referenced hardware are reflected on the A/V Drawings.***
- ***The AV Contractor is responsible for providing and installing all system components to provide a fully functioning AV system per the below Scope of Work (even if the components are not specifically referenced on the Bill of Materials or A/V Drawings).***

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**Deliverables**

- At the completion of the system installation, the AV Contractor will provide the client with the following deliverables:
  - System As-Built Drawings
  - Control System Programming Code (Un-compiled)
  - Itemized List of All System Hardware including:
    - Building / Room Number
    - Model Number
    - Serial Number
    - MAC Address (if applicable)
    - IP Address (if applicable)
  - Control System Operation Manual

**Training**

- At the completion of the system installation, the AV Contractor will complete a comprehensive system training. This training will cover the following:
  - Review of system signal flow
  - Review of the control of the system

**Other Contractors**

- The following items are not included in the AV scope of work and will be provided/installed by the electrical/low voltage contractor:
  - All electrical requirements
  - All network requirements
  - All conduits, back boxes and floor boxes

**Warranty**

- Included in the pricing of this proposal, the AV Contractor will warrant the system installation for (2) two years from project substantial completion.

**Functional Narrative:**

Classrooms - TYPICAL

- Wall-mounted 75” Smart Interactive Monitor
- Speakers internal in the monitor will be utilized
- HDMI and USB wall plate for connection of instructor computer
- The system will be controlled using the wireless remote control that ships with the monitor

Music Room

- Wall-mounted 75” Smart Interactive Monitor
- Speakers internal in the monitor will be utilized
- HDMI and USB wall plate for connection of instructor computer
- The system will be controlled using the wireless remote control that ships with the monitor

Art Room

- Wall-mounted 75” Smart Interactive Monitor
- Speakers internal in the monitor will be utilized
- HDMI and USB wall plate for connection of instructor computer
- The system will be controlled using the wireless remote control that ships with the monitor

SGR Rooms - TYPICAL

- Wall-mounted 65” Smart Interactive Monitor
- Speakers internal in the monitor will be utilized
- HDMI and USB wall plate for connection of instructor computer
- The system will be controlled using the wireless remote control that ships with the monitor

Science Rooms - TYPICAL

- 75” Smart Interactive Monitor on rolling cart
- Speakers internal in the monitor will be utilized
- Loose HDMI and USB cables for connection of instructor computer
- The system will be controlled using the wireless remote control that ships with the monitor

"Shell" Future Use Room

- 75” Smart Interactive Monitor on rolling cart
- Speakers internal in the monitor will be utilized
- Loose HDMI and USB cables for connection of instructor computer
- The system will be controlled using the wireless remote control that ships with the monitor

Library

- (2) Wall-mounted 75” Smart Interactive Monitors
- Speakers internal in the monitor will be utilized
- (2) HDMI and USB wall plate for connection of instructor computer
- The systems will be controlled using the wireless remote control that ships with the monitor
  - TWO SEPARATE INDEPENDENT SYSTEMS

Conference Rooms - TYPICAL

- Wall-mounted 65” monitor
- Speakers internal in the monitor will be utilized
- HDMI connection at conference table for of computer
- The system will be controlled using the wireless remote control that ships with the monitor

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LGI Room

- Ceiling-mounted 7,000 lumen projector
- Ceiling-recessed electric projection screen
- HDMI wall plate for connection of computer
- (2) Wall-mounted speakers for program audio
- Wall plate connection for portable assisted listening system
- The system will be controlled using a wall-mounted button panel

Cafeteria

- Ceiling-mounted 7,000 lumen projector in protective cage
- Ceiling-recessed electric projection screen
- HDMI wall plate for connection of computer
- (1) Handheld wireless microphone (with rechargeable battery and batter charger)
- (18) Ceiling-mounted pendant speakers for program and wireless microphone audio
- Wall plate connection for portable assisted listening system
- The system will be controlled using a wall-mounted button panel

Gymnasium

- Ceiling-mounted 10,000 lumen projector in protective cage
- Stage-mounted electric projection screen
- HDMI wall plate for connection of computer
- Stereo audio and Bluetooth wall plate for connection of audio device (i.e. phone)
- (1) Handheld wireless microphone and (1) lavalier wireless microphone (with rechargeable batteries and battery chargers)
- (2) Wall-mounted column speakers and (12) ceiling-mounted pendant speakers for all system audio
- Dedicated assisted listening system
- The system will be controlled using a rack-mounted 7” touch panel at the stage

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**Bill of Materials**

Tredyffrin/ Easttown School District New Elementary School Audio Visual Bill of Materials			
Qty	Manufacturer	Manufacturer Part #	Description
<b>Classrooms - TYPICAL OF 30</b>			
			<b>DISPLAY</b>
30	Smart	GX075-V3	75" Interactive Monitor
30	Chief	LTM1U	Tilting Wall-Mount for 75" Interactive Monitor
			<b>VIDEO</b>
30	C2G	C2G31030	HDMI & USB over CAT Extender Kit (Includes Wall Plate Transmitter & Receiver)
<b>Music Room</b>			
			<b>DISPLAY</b>
1	Smart	GX075-V3	75" Interactive Monitor
1	Chief	LTM1U	Tilting Wall-Mount for 75" Interactive Monitor
			<b>VIDEO</b>
1	C2G	C2G31030	HDMI & USB over CAT Extender Kit (Includes Wall Plate Transmitter & Receiver)
<b>Art Room</b>			
			<b>DISPLAY</b>
1	Smart	GX075-V3	75" Interactive Monitor
1	Chief	LTM1U	Tilting Wall-Mount for 75" Interactive Monitor
			<b>VIDEO</b>
1	C2G	C2G31030	HDMI & USB over CAT Extender Kit (Includes Wall Plate Transmitter & Receiver)
<b>SGR Rooms - TYPICAL OF 12</b>			
			<b>DISPLAY</b>
12	Smart	GX065-V3	65" Interactive Monitor
12	Chief	LTM1U	Tilting Wall-Mount for 65" Interactive Monitor
			<b>VIDEO</b>
12	C2G	C2G31030	HDMI & USB over CAT Extender Kit (Includes Wall Plate Transmitter & Receiver)
<b>Science Rooms - TYPICAL OF 2</b>			
			<b>DISPLAY</b>
2	Smart	GX075-V3	75" Interactive Monitor
2	Smart	FS-SBID-200	Rolling Cart for 75" Interactive Monitor
<b>"Shell" Future Use Room</b>			
			<b>DISPLAY</b>
2	Smart	GX075-V3	75" Interactive Monitor
2	Smart	FS-SBID-200	Rolling Cart for 75" Interactive Monitor
<b>Library</b>			
			<b>DISPLAY</b>
2	Smart	GX075-V3	75" Interactive Monitor
2	Chief	LTM1U	Tilting Wall-Mount for 75" Interactive Monitor
			<b>VIDEO</b>
2	C2G	C2G31030	HDMI & USB over CAT Extender Kit (Includes Wall Plate Transmitter & Receiver)

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Conference Rooms - TYPICAL OF 3			
			<b>DISPLAY</b>
3 Panasonic	TH-65QE2U		65" Monitor
3 Chief	LTM1U		Tilting Wall-Mount for 65" Monitor
			<b>VIDEO</b>
3 Crestron	HD-TXC-4KZ-101		HDMI over CAT Transmitter
3 Crestron	HD-RXC-4KZ-101		HDMI over CAT Receiver
Large Group Room			
			<b>DISPLAY</b>
1 Epson	PowerLite L730U		7,000 Lumen, WUXGA Projector (Includes Lens) (V11HA25020)
1 Chief	RPMAU		Projector Mounting Interface
1 CONTRACTOR	MIP		Hardware Rigging and Mounting for Projector
1 Draper	140114U-CUSTOM		Ceiling-Recessed Electric Projection Screen (16:10, 123" Diagonal, 1" Black Drop)
			<b>VIDEO</b>
1 Crestron	HD-TXC-4KZ-101-1G		HDMI over CAT Transmitter Wall Plate
1 Crestron	HD-RXCA-4KZ-101		HDMI over CAT Receiver
			<b>AUDIO</b>
1 Biamp	TesiraFORTECI		DSP
1 Biamp	Voltera A300.2		Amplifier
2 Biamp	DX-S8-B		Surface-Mount Speaker
1 CONTRACTOR	PLATE		3.5mm Assisted Listening Output Plate
			<b>CONTROL</b>
1 Crestron	MPC3-102-B		Wall-Mount Button Controller
1 Netgear	GSM4212P		PoE+ Switch
			<b>FURNITURE</b>
1 Middle Atlantic	DWR-10-17PD		Wall-Mount Equipment Rack (Includes Locking Front Door)
1 Middle Atlantic	PDX-915R		Rack-Mount Power Distribution
Cafeteria			
			<b>DISPLAY</b>
1 Epson	PowerLite L730U		7,000 Lumen, WUXGA Projector (Includes Lens) (V11HA25020)
1 Chief	RPMAU		Projector Mounting Interface
1 Chief	PG1AW		Protective Cage for Projector
1 CONTRACTOR	MIP		Hardware Rigging and Mounting for Projector
1 Draper	140114U		Ceiling-Recessed Electric Projection Screen (16:10, 123" Diagonal)
			<b>VIDEO</b>
1 Crestron	HD-TXC-4KZ-101-1G		HDMI over CAT Transmitter Wall Plate
1 Crestron	HD-RXCA-4KZ-101		HDMI over CAT Receiver
			<b>AUDIO</b>
1 Shure	SLXD4		Wireless Microphone Receiver
1 Shure	SLXD2/SM58		Wireless Handheld Microphone
1 Shure	SB903		Rechargeable Battery for Wireless Handheld Microphone
1 Shure	SBC203-US		Battery Charger for Wireless Handheld Microphone
1 Biamp	TesiraFORTECI		DSP
1 Biamp	Voltera A600.4		Amplifier
22 Biamp	CM60DTD		Ceiling Speaker
1 CONTRACTOR	PLATE		3.5mm Assisted Listening Output Plate
			<b>CONTROL</b>
1 Crestron	MPC3-102-B		Wall-Mount Button Controller
1 Netgear	GSM4212P		PoE+ Switch
			<b>FURNITURE</b>
1 Middle Atlantic	BGR-25SA-27		Floor Standing Equipment Rack
1 Middle Atlantic	CBS-BGR		Caster Base for Floor Standing Equipment Rack
1 Middle Atlantic	PDX-915R		Rack-Mount Power Distribution



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Gymnasium			
			<b>DISPLAY</b>
1	Epson	EB-PJ2010W	10,000 Lumen, WUXGA Projector (No Lens) (V11HA52920)
1	Epson	ELPLM11	Projector Lens (V12H004M0B)
1	Chief	WMA2S	Wall-Mount for Projector
1	Chief	RPMAU	Projector Mounting Interface
1	Chief	PG4A	Protective Cage for Projector
1	CONTRACTOR	MIP	Hardware Rigging and Mounting for Projector
1	Draper	116482 CUSTOM	Ceiling-Suspended Projection Screen (16:10, 189" Diagonal, black case, custom drop)
			<b>VIDEO</b>
2	Oretron	HD-TXC-4KZ-101-1G	HDMI over CAT Transmitter Wall Plate
1	Oretron	HD-PS622	Switcher
			<b>AUDIO</b>
2	RDL	D-CJ3	Stereo Input Wall Plate
1	Rolls	BD87	Portable Bluetooth Receiver
1	Shure	SLXD4D	Dual-Channel Wireless Microphone Receiver
1	Shure	SLXD1	Wireless Belt-pack Transmitter
1	Shure	WL185MB/C-TQG	Lavalier Microphone
1	Shure	SLXD2/SM58	Wireless Handheld Microphone
2	Shure	SB903	Rechargeable Battery for Wireless Handheld Microphone
1	Shure	SBC203-US	Battery Charger for Wireless Handheld Microphone
1	Biamp	TesiraFORTEQ	DSP
1	Biamp	Voltera A600.4	Amplifier
1	Biamp	ALC-404D	Amplifier
12	Biamp	DP8	Pendant Speaker
2	JBL	CBT 70J-1 + 70JE-1	Column Array Loudspeaker System
2	JBL	MTC-CBT-FM1/FM2	Flush-Mount Wall Brackets for Column Array Loudspeaker
2	Joe's Sport Shop	PC56812F	Protective Cage for JBL Column Array Loudspeaker System
2	Joe's Sport Shop	PCWB4	Wall Bases for Protective Cage
1	CONTRACTOR	PLATE	3.5mm Assisted Listening Output Plate
			<b>CONTROL</b>
1	Oretron	TSW-770-B-S	7" Touch Panel
1	Oretron	TSW-570/770-RMK-1	Rack-Kit for 7" Touch Panel
1	Oretron	CP4	Control Processor
1	Netgear	GSM4212P	PoE+ Switch
			<b>FURNITURE</b>
1	Middle Atlantic	DWR-21-22PD	Wall-Mount Equipment Rack (Includes Locking Front Door)
1	Middle Atlantic	PDX-920R	Rack-Mount Power Distribution
1	Middle Atlantic	PDT-615C-NS	Vertical Power Distribution for Equipment Rack
Lobby Digital Signage			
			<b>DISPLAY</b>
1	Panasonic	TH-55CQE2U	55" Monitor
1	Chief	LTM1U	Tilting Wall-Mount for 55" Monitor
			<b>VIDEO</b>
1	BrightSign	XD235	Digital Signage Player
1	BrightSign	SDHC-64C10-1(M)	64GB Class-10 Micro SD Card
1	BrightSign	NETWORK	BrightSign Network (Annual Subscription)
Loose Hardware			
1	WilliamsAV	FM558-24	Assisted Listening System (Includes 24 Receivers)

End of Section – 260000, Appendix A

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SECTION 260400 – BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.
- B. Requirements specified in all other sections of Divisions 26, 27 and 28 apply to this Section.

1.2 SUMMARY

- A. This Section includes general administrative and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 1:
  - 1. Submittals.
  - 2. Coordination drawings.
  - 3. Record documents.
  - 4. Maintenance manuals.
  - 5. Rough-ins.
  - 6. Electrical installations.
  - 7. Cutting and patching.
- B. Related Sections: The following sections contain requirements that relate to this section:
  - 1. Division 26 Section "Common Work Results for Electrical," for materials and methods common to the remainder of Division 26, plus general related specifications including:
    - a. Access to electrical installations.

1.3 SUBMITTALS

- A. General: Follow the procedures specified in Division 1 Section "SUBMITTALS."
- B. Additional copies may be required by individual sections of these Specifications.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 2 through 28 for rough-in requirements.

3.2 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, and materials installation with the building components, construction phasing, sequencing and other work.
  - 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 electrical installations.
  - 4. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
  - 5. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
  - 6. 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.
  - 7. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
  - 8. 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.

3.3 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 1 Section "CUTTING AND PATCHING." In addition to the requirements specified in Division 1, the following requirements apply:
  - 1. Where electrical equipment is removed, patch existing surfaces to match existing adjacent surfaces (i.e. in-fill block with concrete/masonry fill to match the existing). Paint exposed-to-public finishes to match the existing adjacent surfaces.
  - 2. Perform cutting, fitting, and patching of electrical equipment and materials required to:
    - a. Uncover Work to provide for installation of ill-timed Work.
    - b. Remove and replace defective Work.
    - c. Remove and replace Work not conforming to requirements of the Contract Documents.

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- d. Remove samples of installed Work as specified for testing.
  - e. Upon written instructions from the Engineer, uncover and restore Work to provide for Engineer observation of concealed Work.
- 3. Cut, remove, and legally dispose of selected electrical equipment, components, and materials as indicated, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new Work.
  - 4. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
  - 5. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
  - 6. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
  - 7. Patch damaged finished surfaces and building components using new materials matching existing materials and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.
- a. Refer to Division 1 Section "DEFINITIONS AND STANDARDS" for definition of experienced "Installer."

**End of Section 260400**

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SECTION 260500 – 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.

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, cable trays, 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 sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

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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, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
    - e. GPT (Link-Seal), Basis of Design
  - 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: 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.

2.3 INTERIOR RACEWAY SEALS

- A. Description: Inflatable raceway sealing system to prevent water from entering buildings via the inside of raceways routed from the site into the building. All conduits shall be sealed in the building and in handhole locations, prior to routing in the building.
- B. Manufacturer / Product: Raychem Rayflate kit RDSS series or approved equal. Final model shall be based on the size of the raceway and cable sizes within for each application.

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2.4 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, cable trays, 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.



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- 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.
- 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 "Penetration 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 cast-iron 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: Size cores to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.
- N. Exterior manholes and handholes: Install Raychem Rayflate kits in each conduit that is routed from an exterior manhole and/or handhole to the interior of the building in order to prevent ingress of water through the conduit. Each end of the conduit (in the manhole/handhole and in the building) shall have a Rayflate kit to seal the conduits/wiring, including low-voltage wiring.

### 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 "Penetration Firestopping."

END OF SECTION 260500

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SECTION 260513 – MEDIUM VOLTAGE CABLES

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.
- B. Requirements specified in all other sections of Division 26 apply to this Section.

1.2 SUMMARY

- A. This section includes single conductor cables and splices, terminations, and accessories for 15 KV electrical distribution systems.
- B. Related Sections: The following Division 26 Sections contain requirements that relate to this Section:
  - 1. "Raceways and Boxes for Electrical Systems".
  - 2. "Underground Ducts and Raceways for Electrical Systems".

1.3 SUBMITTALS

- A. General: Submit the following in accordance with conditions of Contract and Division 1 Specification Sections.
- B. General: Submit the following:
  - 1. Product data on cables, splices, and cable accessories including descriptions and detailed specifications.
  - 2. Report of Field Tests: Certified copies of field test records.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer of medium-voltage electrical cable to perform the installation specified in this section.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."
- C. IEEE Compliance: Comply with applicable IEEE standards including C2 "National Electrical Safety Code."
- D. UL Compliance: Cables and components shall be listed and labeled by UL.
- E. PECO requirements and regulations.

1.5 WARRANTY

- A. The contractor shall warrant the completed medium voltage cabling to be free from inherent mechanical and electrical defects for a period of two (2) years from the date of Substantial

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Completion.

- B. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion. It will not make any difference when equipment is ordered, delivered or installed, warranties will commence after the Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, and with the PECO standard approved manufacturers, provide products by the following:
1. Cable:
    - a. Pirelli Cable Corp.
    - b. The Kerite Co.
    - c. The Okonite Co.
    - d. General Cable Co.
  2. Cable Splicing and Terminating Products and Accessories:
    - a. Electrical Products Division 3M.
    - b. G&W Electric Co.
    - c. RTE Components.
    - d. Joslyn Mfg. & Supply Company.
    - e. Raychem

### 2.2 MEDIUM-VOLTAGE CABLE

- A. General: Cable shall be single-conductor type, size as indicated, and conforming to UL Standard 1072 "Medium Voltage Power Cables."
- B. Service Requirements: Subject to compliance with requirements of the PECO. Obtain cable approval from the Utility prior to submitting to Engineer.
- C. Cable shall be MV-105, (3) 15kV #2 AWG single conductor copper cable with 100% concentric neutral and 133% insulation. Provide Okoguard-Okoseal Type MV-105 15kV Concentric Power Cable or approved equal. The cable shall have the following characteristics:
1. Conductor: Annealed uncoated copper compact stranded as per ASTM B-496.
  2. Strand Screen: Extruded semiconducting EPR strand screen. Meets or exceeds electrical and physical requirements of ICEA S-93-639/NEMA WC74 & S-97-682, AEIC CS8 and UL 1072.
  3. Insulation: Meets or exceeds electrical and physical requirements of ICEA S-93-639/NEMA WC74 & S-97-682, AEIC CS8 and UL 1072.
  4. Shield: 100% concentric neutral conductors.
  5. Insulation Screen: Extruded semiconducting EPR insulation screen applied directly over the insulation. Meets or exceeds electrical and physical requirements of ICEA S-93-639/NEMA WC74 & S-97-682, AEIC CS8 and UL 1072.
  6. Jacket: Meets or exceeds electrical and physical requirements of ICEA S-93-639/NEMA WC74 & S-97-682, and UL 1072 for polyvinyl chloride jackets. UL Listed as Type MV-105 and sunlight resistant, in accordance with UL 1072.

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7. Cable Voltage Rating: 15kV phase to phase.
8. Cable Jacket: EPR.

### 2.3 MARKER

- A. Cables shall be identified with manufacturers' name, conductor size, conductor material, voltage rating and insulation designation. This information shall appear on the cable covering at regular intervals. A permanent marker indicating the phrase, manufacturer, year of manufacture, and sequential footage number repeated each foot shall be inserted under the copper shielding tape.

### 2.4 ARC PROOF TAPE

- A. In all equipment, manholes and junction boxes, provide and install arc proof tape individually on all 15kV cabling. Provide a ½ lap joint for all arc proof taping installations.
- B. In manholes, the arc proof tape shall be applied over all three conductors. In equipment, the arc proof tape shall be applied over each individual conductor.
- C. Provide 2" wide tape, apply with a ½ lap joint, of 30-mil Plymouth-Bishop 53 Plyarc Arc and Fire Proofing tape or approved equal by 3M or Mac Products, Inc.
- D. Glass Tape: Band the arc-proofing tape with 1-inch-wide bands of half-lapped adhesive glass-cloth tape 2" on center.

### 2.5 SPLICING AND TERMINATING PRODUCTS

- A. General: Comply with the following standards:
  1. IEEE 48: "IEEE Standard Test Procedures and Requirements For High-Voltage Alternating Current Cable Terminations."
  2. IEEE 400: "Guide For Making High-Direct-Voltage Tests on Power Cable Systems in the Field."
  3. IEEE 404: "Standard For Power Cable Joints."
  4. IEEE 592: "Standard For Exposed Semiconducting Shields on Premolded High-Voltage Cable Joints and Separable Insulated Connectors."
  5. UL 486A: "Wire Connectors and Soldering Lugs for Use with Copper Conductors."
  6. UL 486B: "Wire Connectors and Soldering Lugs for Use with Aluminum Conductors."
- B. Types: Compatible with the cable materials.
- C. Connectors: Compression type as recommended by cable or splicing kit manufacturer for the application.
- D. Splicing and Terminating Kits:
  1. For all termination and splice kits, provide compression and mechanical connectors, as required.
  2. Splice kit, heat shrink in-line splice for 1/C shielded cables 5-35kV: Raychem HVS-C-1521S or approved equal.
  3. Outdoor PECO Primary Termination Kit: Heat-shrink outdoor termination kit for 1/C shielded cables 15kV: Raychem HVT-Z-152-SG or approved equal.

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4. Outdoor Termination Kit: Heat-shrink outdoor termination kit for 1/C shielded cables 15kV: Raychem HVT-Z-151-SG or approved equal.
  5. Indoor Termination Kit: Heat-shrink indoor termination kit for 1/C shielded cables 15kV: Raychem HVT-Z-151-G or approved equal.
  6. Elbow terminations on 15kV cable for transformer connections, where applicable: 200A 15kV loadbreak elbows with test point by Elastimold.
- E. Insulation Thickness: Corresponding to 133 percent insulation level in accordance with the referenced standard.
- F. Termination and splices shall be in conformance with PECO requirements; obtain PECO approval prior to submitting and ordering termination kits. The ground connections shall be made with a minimum of #4/0 AWG copper conductor.
- G. Circuit Identification: Color-coded tape (black, red, blue).

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine before pulling cable, raceways, pull boxes, manholes, and other cable installation locations for cleanliness of raceways, minimum bending radii of cables, and conditions affecting performance of cable. Pull a mandrel through raceways to check for suitable conditions. Do not proceed with cable installation until unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION, GENERAL

- A. General: Install cable accessory items in accordance with manufacturer's written instructions and as indicated.

#### 3.3 INSTALLATION OF CABLES

- A. In manholes, handholes, pull boxes, junction boxes and cable vaults, train cables around walls by the longest route from entry to exit and support cables at intervals adequate to prevent sag. Provide minimum 20' cable slack in each manhole. Provide additional wall fiberglass wall racks for cable support in existing manholes, as required.
- B. At PECO termination pole, provide a minimum of 40' of cable slack.
- C. Pull conductors simultaneously where more than one cable is indicated in same raceway. Use UL-listed and manufacturer-approved pulling compound or lubricant where necessary. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means including, fish tape, cable, rope, and basket weave wire/cable grips that will not damage cables or raceways. Do not use rope hitches for pulling attachment to cable.

#### 3.4 INSTALLATION OF SPLICES

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- A. Install splices at pull points and elsewhere as required using standard kit. Conform to kit manufacturer's written instructions.

### 3.5 INSTALLATION OF TERMINATIONS

- A. Install terminations at ends of conductors and seal conductor cable ends with standard kits. Conform to manufacturer's written instructions. Comply with classes of terminations indicated.
- B. Tighten electrical connectors and terminals in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

### 3.6 INSTALLATION OF CABLE ACCESSORIES

- A. Arc-Proofing: Arc-proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial, or termination materials except where indicated. Apply on cables in all manholes, equipment and terminations. Apply as recommended by the manufacturer of the arc-proofing tape and the following:
  - 1. Clean cable sheath.
  - 2. Wrap metallic cable components with 10-mil-pipe wrapping tape.
  - 3. Smooth surface contours with electrical insulation putty.
  - 4. Apply arc-proofing tape in one half-lapped layer with the coated side toward the cable.
  - 5. Band the arc-proofing tape with 1-inch-wide bands of half-lapped adhesive glass-cloth tape 2" on center.

### 3.7 FIELD QUALITY CONTROL

- A. General: Comply with applicable standards of The InterNational Electrical Testing Association (INETA) including the latest Standard ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. Preparation: Perform the following preparations in advance of new cable independent tests:
  - 1. Test cables' insulation resistance.
  - 2. Test circuits' continuity.
  - 3. Furnish a set of Contract Documents and manufacturer's recommendations to test organization.
  - 4. Make power available at test locations.
- C. Schedule tests and notify Architect at least one week in advance of schedule for test Commencement.
- D. Test procedure shall conform to the following:

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1. Independent Testing Organization: Arrange and pay for the services of an independent electrical testing organization in accordance with the requirements of Division 1 Section "Quality Control Services" to perform tests on medium-voltage cable.
  2. Test Objectives: To assure cable installation is operational within industry and manufacturer's tolerances, is installed in accordance with Contract Documents, and is suitable for energizing.
  3. Procedures: Comply with the INETA standard and IEEE 400. Upon satisfactory completion of tests, attach a label to tested components
- E. Tests shall include high-potential test of cable and accessories and such tests and examinations required to achieve specified objectives.
- F. Reports: The testing organization shall maintain a written record of observations and tests, report defective materials and workmanship, and retest corrected defective items. Testing organization shall submit written reports to the Architect and Contractor.

### 3.9 GROUNDING

- A. Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated connector fittings, and hardware in accordance with manufacturer's written instructions.

### 3.10 IDENTIFICATION

- A. Apply color coding for each phase conductor as per PECO and Industry Standard requirements.

END OF SECTION 260513

SECTION 260519 – 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.
  - 3. Sleeves and sleeve seals for cables.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field quality-control test reports.

1.5 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.



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1.6 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Insulated Wire Corp.; a Leviton Company.
  - 2. General Cable Corporation.
  - 3. Senator Wire & Cable Company.
  - 4. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Aluminum Conductors (only where specifically noted and allowed as shown on the drawings): Aluminum, complying with ASTM B 800 and ASTM B 801.
- D. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN. Conductor sizes #12 and #10 shall be solid and #8 and larger shall be stranded.
- E. Type MC Cable: Aluminum armor with copper conductors. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire. Where applicable, Luminary cable may be used for 0-10V lighting applications.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Hubbell Power Systems, Inc.
  - 3. O-Z/Gedney; EGS Electrical Group LLC.
  - 4. 3M; Electrical Products Division.
  - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
- C. For splices made in junction boxes, manholes or handholes outside, use Weatherproof wire nuts that are silicone-filled.

2.3 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

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- 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 with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

## 2.4 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, Inc.
  - 2. Calpico, Inc.
  - 3. Metraflex Co.
  - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
  - 1. 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.
  - 2. Pressure Plates: Stainless steel. Include two for each sealing element.
  - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Stranded for No. 8 AWG and larger.
- B. 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. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- B. Underground Feeders (within building footprint): Type THHN-THWN, single conductors in Type PVC schedule 40 UL listed conduit.
- C. Underground Feeders (outside building footprint): Type XHHW-2, single conductors in Type PVC schedule 40 UL listed conduit. Refer to drawings for ductbanks requiring encasement in 3" of concrete.
- D. Feeders Concealed in Ceilings, Walls, Partitions: Type THHN-THWN, single conductors in raceway.

- E. Use the following wiring methods as indicated for all branch circuits:
  - 1. Outdoor, underground: Type XHHW-2 in PVC schedule 40 UL listed conduit. Refer to drawings for ductbanks requiring encasement in 3" of concrete.
  - 2. Indoor, Type THHN-THWN, single conductors in raceway:
    - a. Mechanical rooms.
    - b. Electrical rooms.
    - c. Sprinkler Rooms
    - d. Above hard / drywall ceilings.
    - e. Corridors.
    - f. Rooms with exposed ceiling structure.
    - g. In concrete block walls.
  - 3. In areas listed above in E2, MC cable jumpers to equipment is acceptable. Maximum MC cable jumper lengths to equipment shall be 6'. Type MC aluminum-clad multi-conductor copper cabling with ground.
  - 4. Indoor, concealed in drywall walls and accessible ceilings and not in areas listed above in E.2.: Type MC aluminum-clad multi-conductor copper cabling with ground.
- F. Dimming Lighting Branch Circuits: Where branch circuit wiring is routed to 0-10V dimming light fixtures and switches, UL listed metalclad type MC-PCS (Luminary) cable. Where required to be in raceway as per E.2 above, in addition to the phase, neutral and ground wires, provide additional 2#16 AWG solid TFN Twisted jacketed pair (purple/gray) rated at 600V for 0-10V controls.
- G. Class 1 Control Circuits: Type MC Cable.
- H. Class 2 Control Circuits: Plenum or Indoor/Outdoor rated type cable, as applicable for the installation location.
- I. Fire Alarm: Type MC FPLP cabling where concealed in walls, cable tray, accessible ceilings, exposed ceilings and partitions and Type THHN-THWN, in raceway where exposed as outlined in E.2 above.

### 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 Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."
- G. Common neutrals shall not be used. Provide individual, dedicated neutral for each circuit.

- H. Common grounds are acceptable, in accordance with the NEC.

### 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.
  - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

### 3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- 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. Rectangular Sleeve Minimum Metal Thickness:
  - 1. For sleeve rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
  - 2. For sleeve rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).
- E. 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.
- F. Cut sleeves to length for mounting flush with both wall surfaces.
- G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and cable unless sleeve seal is to be installed.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."

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- L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground Exterior-Wall Penetrations: Size sleeves to allow for 1-inch (25-mm) annular clear space between cable and sleeve for installing mechanical sleeve seals.

### 3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

### 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Perform tests and inspections and prepare test reports.
- C. Tests and Inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test feeder conductors for compliance with requirements.
    - a. Megger testing for 600V feeder conductors.
  - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- D. Test Reports: Prepare a written report to record the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- E. Remove and replace malfunctioning cabling and retest as specified above.

SECTION 260526 – 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

- A. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:
  - 1. Building grounding.
  - 2. Site pole grounding.
  - 3. Emergency call station grounding.

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. Ground rods.
  - 2. Ground rings.
  - 3. Grounding arrangements and connections for separately derived systems.
  - 4. Grounding for sensitive electronic equipment.
- 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 grounding connections for separately derived systems and telecommunication systems based on NETA MTS.
    - 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.

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#### 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. Stranded Conductors: ASTM B 8.
  - 2. Bonding Conductor: Minimum No. 4 AWG, stranded conductor or as noted on the drawings.
  - 3. 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 Exposed Cables and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
  - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Compression Connectors for all Concealed and Underground Cables: Compression kits of types recommended by kit manufacturer for materials being joined and installation conditions. Must comply with IEEE std 837-2014, UL 467 Listed and CSA 22.2 Certified or approved equal by the Engineer.

#### 2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m in diameter).

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1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.
2. Backfill Material: Electrode manufacturer's recommended material.

### PART 3 - EXECUTION

#### 3.1 APPLICATIONS

- A. Conductors: Install 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. Underground Connections: Compression connectors.
  3. Connections to Ground Rods at Test Wells: Compression connectors.
  4. Connections to Structural Steel: Compression connectors.
  5. Connections to Structural Rebar: Compression connectors.
  6. Connections to Poles and Call Boxes: Bolted connectors.

#### 3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  1. Feeders and branch circuits.
  2. Lighting circuits.
  3. Receptacle circuits.
  4. Single-phase motor and appliance branch circuits.
  5. Three-phase motor and appliance branch circuits.
  6. Flexible raceway runs.
  7. Armored and metal-clad cable runs.
  8. Cable tray systems.
  9. IDF and Audio/PA racks.
  10. Security and Fire alarm panels.

#### 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. Ground Rods: Drive rods until tops are 12 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
  1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.



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- C. 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 compression connectors for outdoor locations.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage an independent 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 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 test well, 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.
  - 4. Panel testing: Perform ground resistance testing between all existing and new panel boards and the main switchboard in the main electrical rooms. Provide test report indicating the resistance for each panel to the main.
- C. Report measured ground resistances that exceed the following values:
  - 1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
  - 2. Power and Lighting Equipment or System with Capacity 500 kVA and More: 5 ohms.
  - 3. Structural Steel / Lightning Protection Grounds: 25 ohms.
- D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

END OF SECTION 260519

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SECTION 260529 – 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 (galvanized).

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. 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.
  - 2. Nonmetallic slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

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1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Nonmetallic slotted channel systems. Include Product Data for components.
4. Equipment supports.

C. Welding certificates.

#### 1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. 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.

### 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. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut; Tyco International, Ltd.
    - g. Wesanco, Inc.
  2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester 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: Galvanized Steel 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.

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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; 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, provide products by one of the following:
      - 1) Hilti Inc.
      - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 3) MKT Fastening, LLC.
      - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
  - 2. Mechanical-Expansion Anchors: Insert-wedge-type, 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, provide products by one of the following:
      - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
      - 2) Empire Tool and Manufacturing Co., Inc.
      - 3) Hilti Inc.
      - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 5) MKT Fastening, LLC.
  - 3. Concrete Inserts: Stainless 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. Hanger Rods: Threaded steel.

## 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 (including trapeze type systems): Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter. Exception:

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1. Where attached to wood framing systems in the building, the support spacing shall be double the requirements scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70.
  2. The intent of this exception is to distribute the loading of the raceways on the wood framing system.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with galvanized 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.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. 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).
- D. 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 by means that meet seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

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3.3 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. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 – RACEWAYS 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, floor boxes, enclosures, surface divided non-metallic raceway and cabinets for electrical wiring.
- B. Refer to Section 260519 for allowable raceway and MC Cable locations.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. FMC: Flexible metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. LFNC: Liquidtight flexible nonmetallic conduit.
- F. RMC or GRS: Galvanized rigid metal 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.
  - 2. For handholes and boxes for underground wiring, including the following:
    - a. Duct entry provisions, including locations and duct sizes.
    - b. Frame and cover design.
    - c. Grounding details.
    - d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
    - e. Joint details.



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- 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Alflec Inc.
  - 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 4. Maverick Tube Corporation.
  - 5. O-Z Gedney; a unit of General Signal.
  - 6. Wheatland Tube Company.
- B. Rigid Steel Conduit: ANSI C80.1 with threaded fittings.
- C. IMC: ANSI C80.6.
- D. EMT: ANSI C80.3, with compression fittings.
- E. LFMC: Flexible steel conduit with PVC jacket.
- F. 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. Fittings for EMT: Die-cast, compression type.
  - 2. Fittings for RGS: Threaded type.
- G. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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1. AFC Cable Systems, Inc.
2. CANTEX Inc.
3. CertainTeed Corp.; Pipe & Plastics Group.
4. Condux International, Inc.
5. ElecSYS, Inc.
6. Electri-Flex Co.
7. Lamson & Sessions; Carlon Electrical Products.
8. Manhattan/CDT/Cole-Flex.
9. RACO; a Hubbell Company.
10. Thomas & Betts Corporation.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Type PVC Schedule 40, unless otherwise indicated.

D. LFNC: UL 1660.

E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

F. Fittings for LFNC: UL 514B.

## 2.3 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Spring City Electrical Manufacturing Company.
9. Thomas & Betts Corporation.

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, galvanized 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:

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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.

#### 2.4 SLEEVES FOR RACEWAYS

- 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 with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

#### 2.5 FLOOR BOXES

- A. Manufacturers:
  1. Hubbell Wiring Devices or approved equal by the Engineer.
- B. Floor Boxes
  1. Refer to the contract drawings for selected floor box types and sizes.
  2. For each floor box, the contractor is required to coordinate:
    - a. The floor slab thickness.
    - b. Floor material type, so the proper floor box cover can be ordered.
    - c. Devices in each box.
    - d. Faceplates for each device type.
    - e. Furniture feed coordination.
    - f. Coordinate with A/V and IT for final raceway sizes prior to installation.
    - g. Dividers as required to separate 600V and low-voltage wiring.

#### 2.6 AV BACKBOXES

- A. Refer to drawing E001 symbol list for specific backbox requirements for AV equipment.

### PART 3 - EXECUTION

#### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

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1. Exposed Conduit: Rigid steel conduit.
  2. Concealed Conduit, Aboveground: Rigid steel conduit.
  3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried or concrete encased ductbank as indicated on the drawings.
  4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFNC.
  5. Boxes and Enclosures, Aboveground: NEMA 250, Type 4X.
- B. Indoors: Comply with the following indoor applications, unless otherwise indicated; refer also to Section "Low-Voltage Electrical Power Conductors and Cables":
1. For allowable indoor raceways and MC Cable, refer to Section 260519.
  2. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  3. Damp or Wet Locations or in Kitchens: Rigid steel conduit.
  4. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
  5. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4X, stainless steel in damp or wet locations.
  6. Unless otherwise noted: EMT with compression fittings.
- 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. Electrical Metallic Tubing: Use die-cast compression fittings.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits in contact with concrete.

### 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 Division 26 Section "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 (2) two bends are allowed.

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- 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. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- J. 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.
- K. 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.
- L. 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 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- 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. Rectangular Sleeve Minimum Metal Thickness:
  - 1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
  - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).
- E. 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.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed.

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- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using 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.
- N. Underground, Exterior-Wall Penetrations: Size cores to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.
- O. Exterior manholes and handholes: Install Raychem Rayflate kits in each conduit that is routed from an exterior manhole and/or handhole to the interior of the building in order to prevent ingress of water through the conduit. Each end of the conduit (in the manhole/handhole and in the building) shall have a Rayflate kit to seal the conduits/wiring.

#### 3.4 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 "Penetration Firestopping."

#### 3.5 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 260533

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SECTION 260543 – UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Requirements of the following Division 26 Sections apply to this Section:
  - 1. "Basic Electrical Requirements."
  - 2. "Basic Electrical Materials and Methods."

1.2 SUMMARY

- A. This section includes underground electrical work including the following:
  - 1. PVC ducts.
  - 2. Steel ducts.
  - 3. Duct banks.
  - 4. Handholes.
- B. Related Sections: The following sections contain requirements that relate to this Section:
  - 1. Division 31 Section "Earth Moving" for general requirements for excavation, backfill and related items for ducts and handholes.
  - 2. Division 03 Section "Cast-in-Place Concrete" for cast-in-place concrete requirements.

1.3 DEFINITIONS

- A. Duct: The general term for electrical conduit and other raceway, either metallic or nonmetallic, specified for use underground, embedded in earth or concrete.
- B. Duct Bank: A group of two or more ducts in a continuous run between two points.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. The shop drawing for ductbank housing the incoming service from the Utility Co. shall be approved by the Utility Co. prior to manufacturing and installation of the above.
- C. Product data for metal accessories for raceway, duct, duct bank materials, and miscellaneous components. Include:
  - 1. Raceways and fittings.

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2. Raceway supports.

D. Shop Drawings: Detail drawings for handholes.

E. Coordination drawings showing duct profiles and coordination with other utilities and underground structures.

#### 1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturers of handholes shall be firms regularly engaged in manufacturing factory-fabricated handholes, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete units at 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 SEQUENCING AND SCHEDULING

A. Coordination of the Work: Coordinate layout and installation of handholes with final arrangement of ducts as influenced by actual final location of other utilities in the field. Coordinate elevations of duct and raceway entrances into handholes with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and assure duct runs drain to handholes and as approved by the Architect.

#### 1.8 EXTRA MATERIALS

A. Furnish the following extra materials matching products installed, packaged with protective covering for storage and with identification labels clearly describing contents.

1. Cable stanchions, support arms, insulators, and associated fasteners in the quantity of 10 percent of those installed for actual use in this project.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



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1. Nonmetallic Ducts:

- a. Anamet, Inc.
- b. Arnco Corp.
- c. Breeze-Illinois, Inc.
- d. Carlon.
- e. Certainteed Products Corp.
- f. Cole-Flex Corp.
- g. Condux International.
- h. Electri-Flex Co.
- i. R&G Sloan Mfg. Co., Inc.
- j. Spiraduct, Inc.

2.2 DETECTABLE TAPE

- A. Provide detectable tape above all underground duct runs for future verification of duct and cable locations.

2.3 DUCTS AND FITTINGS

- A. General: Ducts and duct fittings and accessories for which listing has been obtained by one or more manufacturers shall be UL listed and labeled.
- B. General: Ducts and duct fittings and accessories for which listing has been obtained by one or more manufacturers shall be listed and labeled by a Nationally Recognized Testing Laboratory (NRTL). The term "NRTL" shall be as defined in OSHA Regulation 1910.7.
- C. Galvanized Rigid Steel Conduit: ANSI C80.1.
- D. PVC Externally Coated Rigid Steel Conduit and Fittings: ANSI C80.1 and NEMA RN 1.
- E. Rigid Nonmetallic Conduit (RNC): NEMA TC 1 and UL 651, Schedule 40 or 80, PVC, rated for use with 90 deg C conductors under all installation conditions.
- F. PVC Conduit and Tubing Fittings: NEMA TC 3; match to conduit type and material.
- G. PVC and ABS Plastic Utilities Duct: NEMA TC 6, Type EB for encased burial in concrete, Type DB for direct burial.
- H. Extra Strength PVC Plastic Utilities Duct: NEMA TC 8, Type EB for concrete encasement, Type DB for direct burial.
- I. PVC and ABS Plastic Utilities Duct Fittings: NEMA TC 9; match to duct type and material.
- J. Manufactured Bends: Not less than 36-inch radius.

2.4 CAST-IN-PLACE CONCRETE

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- A. Conform to Division 03 Section "Cast-in-Place Concrete" for concrete and reinforcing.
- B. Aggregate For Duct Encasement: 3/8-inch maximum size.
- C. Strength: 3000 psi minimum 28-day compressive strength.

## 2.5 RACEWAY/DUCT SEALING

- A. For all handholes: Install Raychem Rayflate kits in each conduit that is routed from an exterior handhole to the interior of the building in order to prevent ingress of water through the conduit. Each end of the conduit (in the handhole and in the building) shall have a Rayflate kit to seal the conduits/wiring.

## 2.6 DUCT BANK ACCESSORIES

- A. Duct Supports: Rigid PVC spacers selected to provide minimum duct spacings and concrete cover depths indicated, while rigidly supporting ducts during concreting.

## 2.7 HANDHOLES

- A. Description: Comply with the latest revision / edition of ANSI/SCTE 77.
  - 1. Color of Frame and Cover: Gray.
  - 2. Configuration: Units shall be designed for flush burial and have open 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" or "COMMUNICATIONS".
  - 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
  - 7. Handholes 12 inches wide by 12 inches long and larger shall have inserts for cable racks and pulling-in irons installed.
  - 8. Listings: UL listed.
  - 9. Ratings: ANSI/SCTE 77 Tier 22.
  - 10. Dividers: Provide handhole dividers to separate differing voltage ratings of the wiring, as required by code.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Armorcast Products Company.
    - b. Carson Industries LLC.
    - c. CDR Systems Corporation.
    - d. NewBasis.
    - e. Quazite.

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PART 3 - EXECUTION

3.1 WIRING METHOD

- A. General: Install ducts for wiring runs indicated. Provide sizes as indicated.
- B. Single and Multiple Duct Runs: PVC schedule 40 conduit, encased in a minimum of 3" of concrete on all sides, with a #4/0 grounding conductor run within 2" of the top of the ductbank.

3.2 EXCAVATION AND BACKFILL

- A. Excavation and Backfill: Conform to Division 31 Section "Earth Moving," except heavy-duty, hydraulic-operated compaction equipment shall not be used and trenching for ducts shall conform to the following:
  - 1. Excavation: Cut trenches neatly and uniformly, and slope uniformly to required pitch.
  - 2. For direct-buried, non-encased ducts prepare trench bottoms free from stones, soft spots, and sharp objects. Where necessary, add a 3-inch layer of stone-free sand or earth to trench bottom and compact to density of adjacent undisturbed soil to provide suitable bearing for ducts. Backfill over and around ducts on bottom of trench with stone-free sand or earth to 6 inches minimum above tops of ducts and compact by hand or pneumatic tamper to density of adjacent undisturbed earth.
  - 3. For each additional layer of direct-buried ducts above bottom ducts, backfill over and around each layer of ducts with stone-free sand or earth to 6 inches minimum above tops of ducts and compact by hand or pneumatically to density of adjacent undisturbed earth.
  - 4. Separation Between Direct-Buried, Non-encased Ducts: Three inches minimum for like services, and 12 inches minimum between power and signal ducts.

3.3 INSTALLATION OF DUCTS

- A. Slope: Pitch ducts to drain towards handholes and away from buildings and equipment. Minimum slope shall be 4 inches in 100 ft. Where necessary to achieve this between handholes, slope ducts from a high point in the run to drain in both directions. Drive stakes in the bottom of the trench at 6 ft. intervals maximum, and use to establish slope.
- B. Curves and Bends: Use manufactured elbows for stub-ups at equipment and at building entrances. For all other curves and bends, except as otherwise indicated, use manufactured long sweep bends in both horizontal and vertical directions.
- C. Joints in ducts and fittings shall be made up watertight in accordance with manufacturer's instructions. Couplings shall be staggered so those of adjacent ducts do not lie in the same plane.
- D. Duct Entrances to Buildings: Rigid Galvanized Steel conduit. Transformations from underground duct to conduit shall be made 10 ft. minimum, outside the building wall and shall use fittings manufactured for the purpose. Install in accordance with the following:
  - 1. Concrete-Encased Ducts: Install reinforcing in duct banks through disturbed earth near buildings and excavations and coordinate duct bank with structural design at wall so duct bank is supported at wall without reducing structural or watertight integrity.
  - 2. Refer to Section 260533 for Link-Seal type conduit seals for each conduit entrance to the building.

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3. Provide Raychem Rayflate kits at each end of conduit entries to the building for sealing.
- E. Concrete-Encased Nonmetallic Ducts: Support on plastic separators coordinated with duct size and required duct spacing, and install in accordance with the following:
  1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, and secure separators to the earth and to ducts to prevent floating during concreting. Do not use tie wires or reinforcing steel in such a way as to form conductive or magnetic loops around ducts or duct groups.
  2. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not use power-driven agitating equipment unless specifically designed for duct bank application. Pour each run of envelope between manholes or other terminations in one continuous operation. Where more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into the concrete on each side of the joint near the corners of the envelope.
  3. Reinforcing: Reinforced duct banks where they cross disturbed earth and where indicated. Size and arrangement of reinforcing steel as indicated.
  4. Forms: The walls of the trench may be used to form the side walls of the duct bank provided the soil is self-supporting and concrete envelope can be poured without soil inclusions. Use forms where the soil is not self-supporting.
  5. Minimum Clearances Between Ducts: Three inches between ducts and exterior envelope wall, 3 inches between ducts for like services, and 12 inches between power and signal/communication ducts.
  6. Depth: Except as otherwise indicated, top of duct bank shall be 24 inches below finished grade, minimum, in nontraffic areas, and 30 inches below finished grade, minimum, in vehicular traffic areas.
- F. Stub-ups: Duct stub-ups to equipment shall be galvanized rigid steel. For equipment mounted on outdoor concrete pads, steel conduit shall extend a minimum of 5 ft. away from edge of pad. Install insulated grounding bushings on the terminations. The steel conduits shall be coupled to the ducts with adapters designed for the purpose and the whole encased with 3 inches of concrete.
- G. Sealing: For ducts to be wired in this project, provide temporary closure at terminations. For spare ducts, seal bore of ducts at terminations. Use sealing compound and plugs as required to withstand 15 psi minimum hydrostatic pressure.
- H. Pulling Cord: Install heavy-duty nylon pulling cord in ducts including spares.

### 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.

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- 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 FIELD TESTING

- A. Duct Integrity: Rod ducts with a mandrell 1/4-inch smaller in diameter than internal diameter of ducts. Where rodding indicates obstructions in ducts, remove the obstructions and retest.

3.6 CLEANING AND RESTORATION.

- A. Clean Ducts: Clean full length of ducts with a round bristle brush with a diameter 1/2 inch greater than internal diameter of duct.
- B. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated. Restore disturbed paving as indicated.

END OF SECTION 260543

## SECTION 260533 – 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. Underground-line warning tape.
  - 4. Warning labels and signs.
  - 5. Instruction signs.
  - 6. Equipment identification labels.
  - 7. 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.
- C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

#### 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.

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- 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 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. Emergency Circuits: Black letters on a red field.
  - 3. Legend: Indicate system or service and voltage, if applicable.
- 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.

### 2.3 UNDERGROUND-LINE WARNING TAPE

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
  - 1. Not less than 6 inches (150 mm) wide by 4 mils (0.102 mm) thick.
  - 2. Compounded for permanent direct-burial service.

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3. Embedded continuous metallic strip or core (detectable).
4. Printed legend shall indicate type of underground line.

## 2.4 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. Warning label and sign shall include, but are not limited to, the following legends:
  1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

## 2.5 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.

## 2.6 IDENTIFICATION LABELS

- A. Adhesive Film Label with Clear Protective Overlay: 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 ultraviolet-resistant seal for label.

## 2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Plenum rated, 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.
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.



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PART 3 - EXECUTION

3.1 APPLICATION

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service and Feeders: Identify with orange self-adhesive vinyl label.
- B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands or snap-around, color-coding bands:
  - 1. Fire Alarm System: Red.
  - 2. Fire-Suppression Supervisory and Control System: Red and yellow.
  - 3. Combined Fire Alarm and Security System: Red and blue.
  - 4. Security System: Blue and yellow.
  - 5. Mechanical and Electrical Supervisory System: Green and blue.
  - 6. Telecommunication System: Green and yellow.
  - 7. Control Wiring: Green and red.
- C. Power-Circuit Conductor Identification: For primary and secondary conductors No. 1 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape and aluminum or plastic wraparound marker labels. Identify source and circuit number of each set of conductors. For all 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 color-coding conductor tape. For all conditions (with one or more conductors in a box), 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. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply baked-enamel warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
  - 1. 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.

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- I. 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.
- J. 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: Self-adhesive, 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 with a minimum of (2) stainless steel fasteners.
    - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
  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, including all overcurrent devices.
    - d. Transformers.
    - e. Electrical substations.
    - f. Emergency system boxes and enclosures.
    - g. Motor-control centers.
    - h. Disconnect switches.
    - i. Enclosed circuit breakers.
    - j. Motor starters and drives.
    - k. Push-button stations.
    - l. Power transfer equipment.
    - m. Contactors.
    - n. Remote-controlled switches, dimmer modules, and control devices.
    - o. Battery inverter units.
    - p. Battery racks.
    - q. Power-generating units.
    - r. Transfer switches.
    - s. Voice and data cable terminal equipment.
    - t. Master clock and program equipment.
    - u. Intercommunication and call system master and staff stations.
    - v. Audio components, racks, and controls.
    - w. Fire-alarm control panel and annunciators.
    - x. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
    - y. Monitoring and control equipment.
    - z. Uninterruptible power supply equipment.

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- aa. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
- bb. Mechanical, Plumbing and Architectural equipment: Panel source and circuit number on engraved label.
- cc. Receptacles and switches (including low-voltage lighting control switches), including panel source and circuit number. Minimum 10 pt font. See 3.2.K below for additional requirements.

### 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.
  - 3. Colors for 480/277-V Circuits:
    - a. Phase A: Brown.
    - b. Phase B: Orange.
    - c. Phase C: Yellow.
  - 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.

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- 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. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
- J. Painted Identification: Prepare surface and apply paint according to Division 09 painting Sections.
- K. For all Receptacles and Switches, provide the following labeling: Provide clear, self adhesive label on all faceplates with minimum 10 pt black lettering identifying the panel source and circuit number.

END OF SECTION 260553

SECTION 260573 – 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. The Electrical Contractor is responsible to provide the full short circuit, coordination and arc flash study with field applied arc flash labeling, including equipment provided by other contractors. Close coordination with other contractors and vendors is required prior to submitting the study.
- B. This coordination studies, and the setting of these devices.
  - 1. Coordination Section includes computer-based, fault-current and overcurrent protective device of series-rated devices is permitted where indicated on Drawings.
  - 2. Arc Flash analysis and arc flash labeling of equipment.
  - 3. Where indicated on the plans and single line diagrams, the manufacturer shall provide selectively coordinated breakers and panelboards for the Life Safety emergency system. Study shall provide evidence the breakers are selectively coordinated.
    - a. As per NFPA 99, the selective coordination shall be to 0.1 seconds on the time current curves, not fully coordinated.
  - 4. The contractor is responsible to provide all equipment nameplates, ratings, types, feeder sizes, feeder lengths, etc. to the engineer performing this study.
  - 5. The extent of this study shall include:
    - a. All equipment shown on the single line diagram, including the solar PV system provided and installed by the Solar Panel Vendor.
    - b. All mechanical equipment to verify the SCCR ratings are adequate.

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. Study Submittals:

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1. Coordination-study input data, including completed computer program input data sheets.
2. Coordination-study report, including time current curves.
3. Short circuit study.
4. Equipment evaluation report.
5. Setting report.
6. Arc flash report.
7. Arc flash labels.

#### 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 organization experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
- C. Testing Agency Qualifications: Member company of the InterNational Electrical Testing Association.
  1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise testing specified in Part 3.
- D. Comply with IEEE 399 for general study procedures.
- E. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

### PART 2 - PRODUCTS

#### 2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Computer Software Developers: Subject to compliance with requirements, provide computer software programs developed by:
  1. SKM Systems Analysis, Inc. (Basis of Design).
- B. A USB thumb drive with an electronic version of all the files provided in the study shall be included in the final submittal.

#### 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, Table 7-4.

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- 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.

### 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.
- B. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices not submitted for approval with coordination study may not be used in study.

#### 3.2 FAULT-CURRENT STUDY

- A. Source Impedance: Utility company's fault-current contribution as indicated by the Utility. Contractor is responsible to acquire necessary Utility information to complete the study.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project and use approved computer software program to calculate values. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- 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 the following:
  - 1. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.50.
  - 2. Low-Voltage Fuses: IEEE C37.46.
  - 3. Circuit Breakers: IEEE C37.13.
- E. Study Report: Enter calculated X/R ratios and interrupting (5-cycle) fault currents on electrical distribution system diagram of the report. List other output values from computer analysis, including momentary (1/2-cycle), interrupting (5-cycle), and 30-cycle fault-current values for 3-phase, 2-phase, and phase-to-ground faults.
- F. Equipment Evaluation Report: Prepare a report on the adequacy of overcurrent protective devices and conductors by comparing fault-current ratings of these devices with calculated fault-current momentary and interrupting duties.

#### 3.3 COORDINATION STUDY

- 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 showing the following:
    - a. Load current that is the basis for sizing continuous ratings of circuits for cables and equipment.
    - b. Circuit-breaker and fuse-current ratings and types.
    - c. Relays and associated power and current transformer ratings and ratios.
    - d. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
    - e. Generator kilovolt amperes, size, voltage, and source impedance.
    - f. Cables. Indicate conduit material, sizes of conductors, conductor insulation, and length.
    - g. Busway ampacity and impedance.
    - h. 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:
    - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    - b. Magnetic inrush current overload capabilities of transformers.
    - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    - d. Ratings, types, and settings of utility company's overcurrent protective devices.
    - e. Special overcurrent protective device settings or types stipulated by utility company.
    - f. Time-current-characteristic curves of devices indicated to be coordinated.
    - g. 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.
    - h. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
    - i. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.
- B. Perform coordination study and prepare a written report using the results of fault-current study and approved computer software program. Comply with IEEE 399.
- C. Comply with NFPA 70 for overcurrent protection of circuit elements and devices.
- D. Comply with IEEE 242 recommendations for fault currents and time intervals.
- E. Transformer Primary Overcurrent Protective Devices:
1. Device shall not operate in response to the following:
    - a. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
    - b. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.



2. Device shall protect transformer according to IEEE C57.12.00, for fault currents.
  - F. Motors served by voltages more than 600 V shall be protected according to IEEE 620.
  - G. 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. Verify adequacy of phase conductors at maximum three-phase bolted fault currents, equipment grounding conductors, and grounding electrode conductors at maximum ground-fault currents.
  - H. 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 series devices, including power utility company's upstream devices. Show the following specific 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.
    3. Completed data sheets for setting of overcurrent protective devices.
- 3.4 ARC FLASH STUDY
- A. Provide a full Arc Flash Study as per IEEE 1584. The Study shall be based on the worst case scenario of either the minimum or maximum available short circuit current from the Utility and generator(s).
  - B. The preparer shall assume one iteration of balancing breaker settings against arc flash incident energy levels. The goal will be a maximum PPE Level of 2 or less for this project (except at the MDP).
  - C. Provide and install Arc Flash labels on all electric equipment to comply with the latest editions of the NEC and IEEE 1584 and NFPA 70E.
- 3.5 OVERCURRENT PROTECTIVE DEVICE SETTING

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NEW ELEMENTARY SCHOOL COORDINATION STUDY

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- A. Manufacturer's Field Service: Engage an independent, factory-authorized service representative, of electrical distribution equipment being set and adjusted, to assist in setting of overcurrent protective devices within equipment.
- B. Testing: Perform the following device setting and prepare reports:
  - 1. After installing overcurrent protective devices and during energizing process of electrical distribution system, perform the following:
    - a. Verify that overcurrent protective devices meet parameters used in studies.
    - b. Adjust devices to values listed in study results.
  - 2. Adjust devices according to recommendations in Chapter 7, "Inspection and Test Procedures," and Tables 10.7 and 10.8 in NETA ATS.

END OF SECTION 260573

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SECTION 260923 - 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 SYSTEM DESCRIPTION

- A. The distributed lighting control system as specified herein shall be comprised of stand-alone and networked control devices as indicated.
- B. Control devices shall include but not be limited to lighting control panels, room controllers, wall switch stations, occupancy/vacancy sensors, daylight sensors, user interfaces, network interfaces, and related input/output devices.
- C. The contractor shall provide all related conduit, wire, boxes, and mounting hardware to provide a complete and functional installation.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.4 SUBMITTALS

- A. Prior to fabrication and shipment of lighting control components, the manufacturer shall provide submittal documentation for approval under the general provisions of these specifications.
- B. The submittal documentation shall include Class 2 control wire type and routing requirements necessary to match the proposed lighting control components.
- C. Submittal documentation shall include a list of components to be supplied, panel schedules, wiring diagrams, detail drawings, and catalog submittal sheets demonstrating compliance with the specified requirements.
- D. Provide as part of the submittal package a system riser drawing of sufficient detail to indicate relative placement of major system components and the required connections between each.
- E. It shall be the responsibility of the contractor to verify all control wire requirements with the lighting controls manufacturer prior to rough in.
- A. Detailed floor plans shall be provided for every space with lighting controls. Typical riser and wiring diagrams shall be provided to cover all scenarios of different lighting controls in all spaces.

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1.5 PROJECT CONDITIONS

- F. The contractor shall not install lighting control system components in spaces where the ambient temperature cannot be maintained between 0 degrees to 40 degrees C (32 degrees to 104 degrees F) with a maximum humidity of 90%, non condensing.
- G. All stored and installed lighting control components shall be adequately protected from dust and dirt.

1.6 WARRANTY

- A. The lighting control manufacturer shall warrant the system to be free from manufacturing defects for a period of 5 years from shipment.
- B. The warranty shall include replacement parts deemed necessary to restore the system to normal operation.
- C. The manufacturer shall provide telephone technical support and remote diagnostics where applicable during normal business hours excluding manufacturer holidays.
- D. Upon request, the manufacturer shall make available for purchase service contract option(s) which include on-site technician visits for service and repair.

1.7 COORDINATION

- A. 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 system, and partition assemblies.

1.8 SPARE PARTS / ATTIC STOCK:

- A. Provide a minimum of (1) spare device for each model / SKU provided as part of the lighting controls.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The basis for design is the NX Distributed Lighting Control System from Current Lighting. Alternate acceptable by one of the following manufacturers:
  - 1. Lithonia Lighting; Acuity Lighting Group, Inc. (nLight)
  - 2. Cooper Lighting Controls
  - 3. Legrand/Watt Stopper.
- B. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval a minimum of 10 working days prior to the bid date and must be made available to all bidders.
- C. By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring.

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- D. Provide complete shop drawings with deviations to the engineer for review and approval prior to rough-in.

## 2.2 GENERAL

- A. Provide lighting control system hardware that is designed, tested, manufactured, and warranted by a single manufacturer.
- B. System components shall be UL listed under the UL916 Energy Management Equipment standard.
- C. Refer to drawings for model numbers.

## 2.3 DIGITAL ROOM CONTROLLER

- A. As indicated and where shown on the plans, install Current Lighting NXRC series Room Controller(s) to control the quantity of lighting and plug loads required.
- B. Where indicated, the room controller shall provide 0 - 10 volt dimming capability for the required number of dimmable lighting loads.
- C. The room controller shall integrate the functionality of connected control components including wall switch stations, occupancy sensors and daylight sensors to provide the required sequence of operation for the space.
- D. Room controllers and associated room control components shall operate in a totally standalone mode and not require the use of a network, software, computer or server for local control functions.
- E. Mechanical:
  - 1. The room controller housing shall measure 5.75" X 3.85" X 1.3" and be constructed of GSM UL rated 94 HB plastic approved for use in a return air plenum.
  - 2. The housing and shall include an integral 1/2" chase nipple for external mounting to standard junction box knockout.
  - 3. Four RJ45 Smart Port connectors shall be accessible on the side of the enclosure for connection of room control devices.
  - 4. Two recessed push buttons and associated LED indicators shall be accessible on the top of the enclosure to provide override, status, set-up and testing functions.
- B. Electrical:
  - 1. The room controller shall have a single power feed and shall be capable of operation at voltages between 120 and 347 volts AC, 50/60 Hz.

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2. One or two output relays (model specific) shall provide a total combined power switching capacity of 20 amps per unit.
3. Where indicated provide one or two independent 0 - 10 volt dimming channels (model specific) for full range dimming control of fixtures equipped with compatible dimmable ballast or driver.
4. Each dimming output shall have a current sinking capacity of at least 30 mA.
5. The room controller shall be capable of supplying 150 mA of Class 2 auxiliary DC power for use by wall switch stations, occupancy sensors, and daylight sensors connected to the room controller's four RJ45 Smart Port connectors.
6. Where indicated, room controllers shall be equipped with power monitoring circuitry capable of measuring and reporting the total connected load for each room controller.

C. Functional:

1. Provide an integral pushbutton and LED indicator for each load for status and to allow operation of the relays and dimmers for testing and verification without requiring other control devices to be connected.
2. The room controller shall have a default operation providing an automatic logical sequence of operation for each load as the room control devices are plugged into the Smart Port connectors.
3. Default operation for occupancy sensors shall be automatic on, automatic off for all loads.
4. Upon connection of a switch, the operation shall automatically change to manual on, automatic off (vacancy) mode for all loads.
5. Provide capability to convert each load independently to automatic on or vacancy mode using only the integral push buttons and LED indicators on the room controller.
6. When in vacancy mode, provide a 30 second grace period after an off during which automatic on shall be temporarily enabled.
7. It shall be possible to connect up to eight (8) room controllers together using Cat5 patch cables to provide configurations up to 16 switched and dimmed loads operating as a single zone.
8. Provide the following set up and configuration functions without the need for additional devices or software:
  - a. Assign/reassign relays for control by wall switch station buttons
  - b. Configure relays for occupancy or vacancy operation
  - c. Assign/reassign dimmers to raise/lower switches
  - d. Assign dimming channels for response to daylight sensor control
  - e. Auto calibrate default daylight sensor sequence of operation
  - f. Save preset scenes

2.2 BLUETOOTH RADIO MODULE

- A. Provide (1 per project) of the optional NXBTR Bluetooth<sup>®</sup> radio module and smart phone app shall allow wireless setup and configuration of the room controller and connected devices through a user-supplied IOS or Android smart phone or tablet. The application shall provide as a minimum:

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1. Configure wall switch button types. At a minimum, button types shall include toggle on/off with pilot, preset, on only and off only
2. Configure up to six zones of daylight harvesting per room with independent set points and time delays
3. Include or exclude loads from occupancy sensor control
4. Configure up to 16 load groups per room
5. Configure up to 16 preset scenes per room with independent fade times
6. Set independent power up conditions for relays and dimmers
7. Set independent occupied and unoccupied conditions for each relay and dimmer
8. Adjust dimmer high and low trim points
9. Manually control loads allowing use of the phone or tablet as a personal control for the room

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## 2.3 SMART PORT MODULE

- A. Where indicated, provide the NXSP Smart Port Module.
- B. Each smart port module shall have four RJ-45 smart ports for connection of digital wall switch stations, occupancy sensors, and photocells to the networked system.
- C. Devices connected to the smart port module shall be network visible and configurable to operate with panels and room controllers via the web browser user interface.

## 2.4 LOW VOLTAGE SWITCH STATIONS

- A. Low voltage digital wall switch stations shall be of the programmable type using standard Cat5 cabling for connection to system smart port.
- B. Stations shall have one to six buttons and provide lighting control functions as called out and shown on the plans.
- C. All switches shall be single gang and be of the generic decorator style allowing easy ganging and use of a wide array of standard wall switch plate options.
- D. Provide two RJ-45 ports per switch to allow for daisy chain connection of up to eight switches to each smart port.
- E. Switch station color shall be white, ivory, light almond, grey, or black as indicated.

## 2.5 OCCUPANCY SENSORS

- A. Occupancy sensors shall be ceiling or wall mounted and use dual technology (ultrasonic and passive infrared), ultrasonic and/or passive infrared (model specific) sensing technology as indicated.

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- B. Sensors shall be Class 2 and connect to any room controller smart port using a wiring adaptor and standard Cat5 patch cable.
- C. Occupancy sensors shall be self adaptive and not require manual calibration after installation. Digital circuitry and logic shall automatically make adjustments to the sensitivity and time delay based on learned occupancy patterns and the environment in which the sensor is installed.
- D. Sensors using both ultrasonic and passive infrared (dual technology) shall operate such that detection by both technologies is required to initiate occupancy and continued detection by either technology will maintain occupancy.
- E. Up to four occupancy sensors may be connected to one room controller.
- F. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
  - 1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  - 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  - 3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
  - 4. 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.
  - 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
  - 6. Bypass Switch: Override the on function in case of sensor failure.
  - 7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); keep lighting off when selected lighting level is present.
- G. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
  - 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): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
  - 3. Detection Coverage (Corridor): Detect occupancy within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling.
- H. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
  - 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. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.



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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. 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.
  5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 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).
- I. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be 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.
- 2.6 Relay Panel for Exterior Lighting Control:
- A. CX Lighting Control Panel by Current Lighting or approved equal.
1. LCD user interface with keypad
  2. Minimum 8 relay panel
  3. Fully populated.
  4. Astronomical and real time clock for scheduling
  5. Upload or save programming via removable SD memory card
  6. NEMA 1 surface mount Enclosure
  7. UL916, UL924 and cUL listed
  8. 5 year limited warranty
- B. Photocell: Outdoor photocell compatible with the CX relay panel.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install all equipment in accordance with manufacturer's installation instructions.
- B. The lighting controls shall be installed in accordance with specific guidelines and submittal documents provided by the lighting control manufacturer.
- C. Where variations from the general specifications or drawings exist, the contractor shall request a clarification prior to rough in or installation.
- D. The contractor shall verify all wire type and routing requirements with the lighting controls manufacturer prior to installation. Not part of this section are requirements for work including, but not limited to, raceways, electrical boxes, junction boxes, circuit protection, wiring, and fittings required for installation of the lighting control equipment.

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### 3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).
- B. Wiring within Enclosures: Comply with NECA 1. 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 Division 26 Section "Identification for Electrical Systems."
  - 1. Identify controlled circuits in lighting contactors.
  - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
  - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

### 3.5 STARTUP AND PROGRAMMING

- A. Pre-programming meeting: The field engineer shall meet with the Owner and project design engineer prior to starting any onsite programming in order to confirm the sequence of operation for each different type of lighting control systems in each unique space.
- B. The system manufacturer shall provide a factory authorized field engineer to the project site after installation has been completed and prior to system energization for the purpose of testing and adjustment of the system. Factory field engineer shall test and verify all system functions and ensure proper operation of the system components in accordance with the specifications and on-site conditions. The installing contractor shall notify the system manufacturer in writing that the system is completely wired and ready to be energized and tested 2 weeks prior to scheduling a field engineer for start-up of the system. Should the field engineer arrive on the job site and find the installation incomplete, the installing contractor shall pay the cost of any future visits by the field engineer required to complete the system start-up.
- C. During the start-up procedure, the factory field engineer shall provide programming assistance and guidance to the building operating personnel in order to program the systems for initial operation.

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- D. Allow for up to 4 hours of on-site training on the use and maintenance of the lighting control system to be scheduled at the completion of startup and programming of the system.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide one visit to Project during other-than-normal occupancy hours for this purpose.

3.7 TECHNICAL SUPPORT

- A. The lighting controls manufacturer shall provide reasonable access to factory direct telephone technical support during normal business hours.

END OF SECTION 260923

SECTION 262200 – ULTRA-HIGH EFFICIENCY LOW-VOLTAGE TRANSFORMERS

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 types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
  - 1. Distribution transformers.
    - a. Ultra-High Efficient Transformers

1.3 DEFINITIONS

- A. Linear Load: A load (i.e., a motor, incandescent lamp, resistor) that does not influence the shape of the original sinusoidal current waveform but may change the relative timing (phase angle) between the sinusoidal voltage and current waveform.
- B. Nonlinear Load: A load (i.e. rectifier, arc, motor drive, switch-mode power supply, fluorescent lamp) that influences the shape of the current waveform resulting in a condition in which total harmonic distortion of current (THD<sub>I</sub>) is greater than total harmonic distortion of voltage (THD<sub>V</sub>). Because the current supplying a nonlinear load is interrupted by a switching action, the current contains frequency components (harmonics) that are multiples of the fundamental frequency.
- C. Total Harmonic Distortion of Current (THD<sub>I</sub>): A measure of the harmonic current distortion present in a system or sub-system defined as the ratio of the sum of all harmonic current frequency components to the fundamental current frequency component.
- D. Total Harmonic Distortion of Voltage (THD<sub>V</sub>): A measure of the harmonic voltage distortion present in a system or sub-system defined as the ratio of the sum of all harmonic voltage frequency components to the fundamental voltage frequency component.

1.4 ACTION SUBMITTALS

- A. Product Data: Submit the following information for review and approval by the engineer of record prior to delivery and installation of each transformer that is to be supplied for this project.
  - 1. Nameplate kVA rating.
  - 2. Nominal Voltage rating, primary and secondary.
  - 3. Winding configuration, primary and secondary.

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4. Core and coil materials.
5. Taps, quantity and configuration.
6. Dimensions.
7. Weight.
8. Accessories.
9. Performance Characteristics:
  - a. Frequency.
  - b. Impedance.
  - c. Insulation class.
  - d. Temperature rise.
  - e. Sound level.
  - f. BIL rating.
  - g. Inrush data.
  - h. Accessories.
  - i. Loss and efficiency data.

- 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.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Section 260548 "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. Field quality-control test reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

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1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Transformer manufacturers proposing to submit a bid for ultra efficient transformers shall have a minimum of fifteen years' experience in the design and manufacture of ultra efficient transformers. Manufacturing experience in the design and manufacture of general purpose transformers does not qualify.
2. Manufacturer shall be ISO 9001 certified.

B. Source Limitations: Obtain each transformer type through one source from a single manufacturer. Pricing for transformers must be provided separate from other distribution system equipment and must be clearly listed on the bid form based on manufacturer.

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. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.9 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer warrants that the product(s) delivered conforms to the specifications and is free from defects in material and workmanship for the Warranty Period(s) indicated below, pro-rated from the date of Substantial Completion, provided that the product(s) have not been misused, abused, altered, neglected, improperly installed or damaged.

B. Warranty Period: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Terms and Conditions

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- a. General Purpose - Ultra Efficient Transformers: Twenty (20) years pro-rated, with standard limited liability clauses provided that the manufacturer participates in and approves of the product application indicated on the Construction Drawings.
- C. Limit of Liability:
  - 1. Manufacturer's overall liability is limited to the cost of the product or defective part.

## PART 2 - PRODUCTS

### 2.1 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Cores:
  - 1. Three-phase, common core construction with one leg per phase.
  - 2. Grain-oriented, non-aging silicon steel.
  - 3. Anti-vibration pads shall be installed between the core and the enclosure.
  - 4. All transformers 112.5 kVA and above shall utilize a miter-cut core to achieve ultra-low, no-load losses and the core shall be constructed with no more than three laminations per vertical or horizontal group.
- C. Coils: Continuous windings without splices except for taps.
  - 1. Internal Coil Connections: Brazed type.
  - 2. Coil Material: Copper.
- D. Voltage Class: 1.2 kV.
- E. BIL Rating: 10 kV
- F. Magnetic Field: 0.1 Gauss at a maximum of 18 inches.
- G. Losses and Efficiency:
  - 1. Linear load losses and efficiency:
    - a. Linear losses and efficiency shall be determined in accordance with U.S. Department of Energy (DOE) Code of Federal Regulations (CFR) requirements as defined in Energy, 10 CFR, §431, Subpart K, Appendix A (2015) using the "Open Circuit and Short Circuit Test Method". Manufacturers shall provide proof of compliance Type Tests for each transformer type and kVA rating. Type Tests are required with each submission.
    - b. Linear loss curves (0 percent to 100 percent full load) shall be provided for each transformer type and kVA rating. Linear losses at 0 percent, 15 percent, 25 percent, 35 percent, 50 percent, 75 percent and 100 percent of full load shall be easily identified on each transformer loss curve AND shall be identified separately in table or other form to the nearest thousandth of a kilowatt (kW).

- c. Linear efficiency curves (0 percent to 100 percent full load) shall be provided for each transformer type and kVA rating. Linear efficiency ratings at 0 percent, 15 percent, 25 percent, 35 percent, 50 percent, 75 percent, and 100 percent of full load shall be easily identified on each transformer efficiency curve and shall be identified separately in table or other form to the nearest one hundredth of one percent.

2. Nonlinear load losses and efficiency:

- a. Currently, there are no recognized standards for “measuring” transformer losses and determining transformer efficiencies under nonlinear load conditions. Therefore, nonlinear losses and efficiencies must be calculated in accordance with IEEE Std. C57.110-2004, “IEEE Recommended Practice for Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents”. Manufacturers shall provide proof of compliance calculations for each transformer type and kVA rating. Calculations are required with each submission.
  - 1) IEEE Std. C57.110-2004 enables any transformer manufacturer to utilize the known linear losses and efficiencies of their transformers, which must be obtained using the “Open Circuit and Short Circuit Test Method”, defined in Energy, 10 CFR. §431, Subpart K, Appendix A (2015), to calculate the nonlinear losses and efficiencies of those same transformers under any “specific” nonlinear load condition. For the purposes of this specification, a “specific” nonlinear load condition shall be characterized by the transformer’s load level (as a percentage of nameplate kVA rating), load K-Factor and FHL (Harmonic Loss Factor), load harmonic spectrum including harmonic magnitudes and load %THDi.
  - 2) Nonlinear load testing programs that incorporate the use of capacitors, inductors, resistors, rectifiers, switch-mode power supplies or other electronic loads in an effort to simulate perceived, real world nonlinear load conditions in a controlled manufacturing environment are not acceptable since (i.) these testing programs are unique to each manufacturer, (ii.) non-duplicable due to source impedance variations at each manufacturer’s facility and (iii.) highly inaccurate due to significant and unavoidable loss measurement and calculated efficiency errors that exist when using the “Power-In - Power-Out Method”. As documented by ANSI/IEEE, when using the “Power-In - Power-Out Method” to determine input and output power characteristics, the loss measurement error may exceed plus or minus 51.6 percent and calculated efficiency error may exceed plus or minus 1.34 percent, even when using synchronized, revenue class CTs, VTs and Wattmeters.
  - 3) Additionally, nonlinear load testing programs receive no professional, technical or governmental oversight since there are no recognized nonlinear testing standards that can be used for reference. This inevitably gives manufacturers the liberty to develop their own unique testing protocols which cannot be compared and evaluated equally against other manufacturers’ who may have completely different testing protocols.
- b. Nonlinear loss curves (0 percent to 100 percent full load) shall be provided for each transformer type and kVA rating based on a “specific” nonlinear load condition characterized by having a 35% of nameplate kVA load, UL 1561 load K-Factor of K13, load harmonic spectrum equal to [1st-1.0, 3rd-0.150, 5th-0.320, 7th-0.250, 9th-0.080, 11th-0.150, 13th-0.125, 15th-0.040] and %THDi of 48.32%. Nonlinear losses at 0 percent, 15 percent, 25 percent, 35 percent, 50 percent, 75 percent and 100 percent of full load shall be easily identified on each transformer loss curve AND



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shall be identified separately in table or other form to the nearest thousandth of a kilowatt (kW).

- c. Nonlinear efficiency curves (0 percent to 100 percent full load) shall be provided for each transformer type and kVA rating based on the same "specific" nonlinear load condition used to calculate nonlinear losses (refer paragraph b. above). Nonlinear efficiency ratings at 0 percent, 15 percent, 25 percent, 35 percent, 50 percent, 75 percent and 100 percent of full load shall be easily identified on each transformer efficiency curve AND shall be identified separately in table or other form to the nearest one hundredth of one percent.

## 2.2 DISTRIBUTION TRANSFORMERS

- A. General Purpose, Isolation Transformers for Medium K-Factor Loads (K-Factor Greater Than 4.0 and Less Than or Equal to 13.0 and THDi Less Than or Equal to 40 percent):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Power Quality International LLC, Type EY (Z3+), with 14.2% lower losses than required by Energy, CFR 10 §431.196(a)(2) (2015) or comparable product by one of the following. Just because a manufacturer is listed below does not absolve them from meeting or exceeding the requirements of all the specification requirements listed herein.

- a. PowerSmiths
- b. PQI

2. General purpose transformer shall be fabricated according to the following:

- a. CAN/CSA Std. C9-M1981.
- b. CAN/CSA Std. C22.2 No. 47-M90.
- c. CAN/CSA Std. C802.2.
- d. ANSI C57.110.
- e. NEMA ST-20.

3. Description:

- a. Single input, single output as indicated on the Drawings.
- b. Energy Efficiency: Low voltage, dry-type, general purpose, distribution transformers shall be ultra-efficient (Z3+) as indicated on Drawings and therefore must meet or exceed all of the following loss and energy efficiency requirements:

- 1) Ultra-Efficient (Z3+), greater than DOE CSL 3 and less than DOE CSL 4:

- a) 14.2% lower losses than Energy, CFR 10 §431.196(a)(2) (2015) under 35 percent linear load conditions
- b) Maximum losses and minimum efficiency under linear load conditions per Table 1 - Z3+ Linear, Ultra Efficient.

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<b>Table 1 - Z3+ Linear, Ultra Efficient</b> <b>Max and Min Values for Losses and Efficiency for “Ultra Efficient” Transformers</b> <b>Exceeding Energy, CFR 10 §431.196(a)(2) (2015) Efficiency Levels Under Linear Loading</b>						
kVA Rating	No Load		35% Load		Full Load	
	Max Loss (kW)	Min Eff. (%)	Max Loss (kW)	Min Eff. (%)	Max Loss (kW)	Min Eff. (%)
15	0.047	0.00	0.094	98.25	0.428	97.22
30	0.079	0.00	0.158	98.52	0.723	97.65
45	0.107	0.00	0.214	98.66	0.980	97.87
75	0.157	0.00	0.313	98.82	1.436	98.12
112.5	0.213	0.00	0.426	98.93	1.951	98.30
150	0.262	0.00	0.525	99.01	2.405	98.42
225	0.358	0.00	0.715	99.10	3.277	98.56
300	0.445	0.00	0.889	99.16	4.075	98.66
500	0.652	0.00	1.305	99.26	5.977	98.82
750	0.885	0.00	1.771	99.33	8.112	98.93
1000	1.092	0.00	2.184	99.38	10.004	99.01

- c) Nonlinear losses and efficiency shall be based on the following:
- i. UL 1561 load K-Factor: K13
  - ii. Harmonic Spectrum:  
1<sup>st</sup> (1.0), 3<sup>rd</sup> (0.150), 5<sup>th</sup> (0.320), 7<sup>th</sup> (0.250), 9<sup>th</sup> (0.080), 11<sup>th</sup> (0.150), 13<sup>th</sup> (0.125), 15<sup>th</sup> (0.040).
  - iii. THDi: 48.32%
- d) Maximum losses and minimum efficiency per Table 2 - Z3+ Nonlinear, Ultra-Efficient, based on the nonlinear load conditions stated in paragraphs c) i., ii. and iii. above.

<b>Table 2 - Z3+ Nonlinear, Ultra-Efficient</b> <b>Max and Min Values for Losses and Efficiency for High Efficiency Transformers</b> <b>Under K13 Nonlinear Loading [THDi: 48.32% , Harmonic Spectrum: 1st (1.0), 3rd (0.150), 5th (0.320), 7th (0.250), 9th (0.080), 11th (0.150), 13th (0.125), 15th (0.040)]</b>						
kVA	No Load		35% Load		Full Load	
	Loss (kW)	Eff. (%)	Loss (kW)	Eff. (%)	Loss (kW)	Eff. (%)
15	0.047	0.00	0.104	98.07	0.575	96.31
30	0.079	0.00	0.179	98.32	1.034	96.67
45	0.107	0.00	0.248	98.45	1.475	96.83

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<b>Table 2 - Z3+ Nonlinear, Ultra-Efficient</b>						
Max and Min Values for Losses and Efficiency for High Efficiency Transformers Under K13 Nonlinear Loading [THDi: 48.32% , Harmonic Spectrum: 1st (1.0), 3rd (0.150), 5th (0.320), 7th (0.250), 9th (0.080), 11th (0.150), 13th (0.125), 15th (0.040)]						
kVA	No Load		35% Load		Full Load	
	Loss (kW)	Eff. (%)	Loss (kW)	Eff. (%)	Loss (kW)	Eff. (%)
75	0.157	0.00	0.365	98.63	2.193	97.16
112.5	0.213	0.00	0.506	98.73	3.110	97.31
150	0.262	0.00	0.627	98.82	3.887	97.47
225	0.358	0.00	0.861	98.92	5.393	97.66
300	0.445	0.00	1.108	98.96	7.252	97.64
500	0.652	0.00	1.643	99.07	10.904	97.87

## c. Configuration:

- 1) kVA Rating: As indicated on drawings.
- 2) Primary Voltage: 480 V.
- 3) Secondary Voltage: 208/120 V.
- 4) System Frequency: 60 Hz.
- 5) Primary winding configuration shall be "Delta". "Wye" connected primary windings shall NOT be used.
- 6) Primary to Secondary Phase Shift: Minus 30 degrees.
- 7) Positive and negative sequence impedance at 60 Hz shall be 3 percent to 6 percent.
- 8) Neutral connection shall be rated at two times the ampacity of the secondary phase current.
- 9) K-Factor Rating:
  - a) Increased K-Factor Rating: Transformers shall be K13 rated and must comply with UL 1561 for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.
  - b) Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
  - c) Indicate value of K-factor on transformer nameplate.

B. List and label as complying with UL 1561.

C. Enclosure: Ventilated, NEMA 250, Type 1, Indoor (Standard) with unless otherwise indicated on Drawings. Transformers shall be furnished without drip shields to minimize width and depth.

1. The front and back covers of the enclosure shall be securely fastened using zinc plated, hexavalent chromium free, captive stainless-steel inserts and hex-head bolts. The use of self-tapping screws to secure the front and back covers is not permitted.

D. Transformer Enclosure (Maximum) Dimensions

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1. 225 kVA: 40"W x 32"D x (No Limit)"H
  2. 112.5 kVA: 31" x 22" x (No Limit)"H
  3. 75 kVA: 31" x 22" x 32"H
- E. Transformer Enclosure Finish: Comply with NEMA 250.
1. Finish Color: ANSI 61 Gray.
- F. Taps for Transformers 15 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.
- G. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature unless otherwise indicated on Drawings.
- H. Wall Brackets: Manufacturer's standard wall mounting brackets shall be provided where indicated on Drawings.
- I. Low-Sound-Level Requirements:
- L. Maximum sound levels, when factory tested according to IEEE C57.12.91, as follows:
- a. 9 kVA and Less: 37 dBA
  - b. 30 to 50 kVA: 42 dBA
  - c. 51 to 150 kVA: 47 dBA
  - d. 151 to 300 kVA: 50 dBA
  - e. 301 to 500 kVA: 52 dBA
  - f. 501 to 750 kVA: 57 dBA
  - g. 751 to 1000 kVA: 59 dBA

## 2.3 IDENTIFICATION DEVICES

- A. Manufacturer's Nameplates: Nameplates (minimum of two required) for each distribution transformer shall be permanently affixed to the left and right side of each transformer enclosure so that the transformer remains permanently identified when front or back covers are removed. The placement of a single manufacturer nameplate on the front cover of the enclosure is unacceptable.
- B. Identification Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer shall be used to identify the transformer name, kVA rating, source name, load name and feeder size for both primary and secondary. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

## 2.4 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.91.

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### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
- B. Construct concrete bases and anchor floor-mounted transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
- C. Provide transformers with vibration isolation neoprene pads at each corner of the transformer. Provide Cooper B-line CNNK-X (sized per weight of transformer) Cork, Ribbed Neoprene and Steel Vibration Pad or equal.

#### 3.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

#### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

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- C. Remove and replace units that do not pass tests or inspections and retest as specified above.
- D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

### 3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

### 3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262200

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SECTION 262416 - PANELBOARDS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division - 1 Specification Section, apply to work of this Section
- B. Requirements specified in all other sections of Division 26 apply to this Section.

1.2 SUMMARY:

- A. Extent of panelboard and enclosure work, including cabinets and cutout boxes, is indicated by drawings and schedules, and as specified herein.
- B. For new circuit breakers to be retrofitted in the existing panelboards, contractor shall survey the existing panel, determine the manufacturer and ratings of the existing breakers and provide new breakers to match and that are retrofittable into the panelboard and have ratings to match the existing breakers.
- C. Types of panelboards and enclosures required for the project include the following:
  - 1. New power-distribution panelboards.
  - 2. New lighting and appliance panelboards.
- D. Refer to other Division-26 sections for wires/cables, electrical boxes and fittings, and raceway work required in conjunction with installation of panelboards and enclosures.
- E. Wires/cables, electrical boxes and fittings, and raceways required in conjunction with the installation of panelboards and enclosures are specified in other Division-26 sections.

1.3 SUBMITTALS:

- A. General: Submit the following in accordance with conditions of Contract and Division 1 Specification Sections.
- B. Product Data: Submit manufacturer's data on panelboards and enclosures.
- C. Wiring Diagrams: Submit wiring diagrams for panelboards showing connections to electrical power feeders and distribution branches.

1.3 QUALITY ASSURANCE:

- A. Installer's Qualifications: A firm with at least 3 years of successful installation experience on projects utilizing panelboards similar to those required for this project.
- B. Codes and Standards:

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3. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Article 384 as applicable to installation, and construction of electrical panelboards and enclosures.
4. UL Compliance: Comply with applicable requirements of UL 67, "Electric Panelboards," and UL's 50, 869, 486A, 486B, and 1053 pertaining to panelboards, accessories and enclosures. Provide panelboard units which are UL-listed and labeled.
5. Special-Use Markings: Provide panelboards, constructed for special-use, with appropriate UL markings which indicate that they are suitable for special type of use/application.
6. NEMA Compliance: Comply with NEMA Stds Pub/No. 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)," Pub/No. PB 1, "Panelboards," and Pub/No. PB 1.1, "Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less."

- C. Federal Specification Compliance: Comply with FS W-P-115, "Power Distribution Panel", pertaining to panelboards and accessories.

#### 1.5 WARRANTY

- A. The contractor shall warrant the completed panelboard wiring and equipment to be free from inherent mechanical and electrical defects for a period of (2) years from the date of Substantial Completion. Refer to Division 1 specifications for definition of Substantial Completion.
- B. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion. It will not make any difference when equipment is ordered, delivered or installed, warranties will commence after the Architect issues his letter of "Substantial Completion."

#### 1.6 SEQUENCING AND SCHEDULING:

- A. Coordinate installation of panelboards and enclosures with installation of wires/cables, electrical boxes and fittings, and raceway work.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or alternatives of the quality necessary to meet the specifications:
  1. Cutler- Hammer
  2. General Electric Co.
  3. Square D / Schneider Electric (Basis of Design)

#### 2.2 PANELBOARDS:



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- A. General: Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials; with the design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes, or ratings are not indicated, comply with NEC, UL and established industry standards for those applications indicated.
- B. Overcurrent Protective Devices (OCPDs): Provide type, rating, and features as indicated. Comply with Division 16 Section "Overcurrent Protective Devices," with OCPDs adapted to panelboard installation. Tandem circuit breakers shall not be used. Multipole breakers shall have common trip.
- C. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box.
- D. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the OCPD ampere ratings indicated for future installation of devices.
- E. Feed-Through Lugs: Sized to accommodate feeders indicated.
- F. Full piano hinge, door-in-door construction.
- G. Special Features: Provide the following features for panelboards as indicated.
  - 1. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box. Install isolated ground bus in the panels feeding computer equipment as indicated on the drawings.
  - 2. Split Bus: Vertical bus of indicated panels divided into two vertical sections with connections as indicated. Provide split bus panels for Normal -Emergency Loads, where indicated.
  - 3. Contactors in Panels: Electrically operated, Mechanically held, with current rating, poles, and connections as indicated.
  - 4. Integral SPD Units - 100kA SPD units bus mounted integrally within the panelboard, where shown on the drawings, and for all electrical panels fed via a Generator (part of the emergency system).
  - 5. 84, 54, or 42 pole panelboards as shown on the contract drawings.

## 2.3 DISTRIBUTION PANELBOARDS

- A. Branch-Circuit Breakers: Use bolt-on breakers.
- B. Power Distribution Panelboards General: Provide dead-front safety type power distribution panelboards as indicated, with panelboard switching and protective devices in quantities, ratings, types, and with arrangement shown; with anti-turn solderless pressure type main lug connectors approved for use with copper conductors. Select unit with feeders connecting at top of panel. Equip with copper bus bars with not less than 98-percent conductivity, and with full-sized neutral bus; provide suitable lugs on neutral bus for outgoing feeders requiring neutral connections. Provide molded-case main and branch circuit-breaker types for each circuit, with toggle handles that indicate when tripped. Where multiple-pole breakers are indicated, provide with common trip so overload on one pole will trip all poles simultaneously. Provide panelboards with bare uninsulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturer as panelboards, which mate and match properly with panelboards.
- C. Distribution panelboards shall be equal to Square D NQ or I-Line distribution panelboards. Power Distribution Panelboards shall be rated minimum 22,000 Ampere R.M.S. Symmetrical, for the 120/208V and 65,000A RMS for 277/480V Volt panelboards, or as shown in the drawings.

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- D. Panelboard Enclosures: Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gage, minimum 16-gage thickness. Construct with multiple knockouts and wiring gutters. Provide fronts with full piano hinge, and doors with flush locks and keys, all panelboard enclosures keyed alike, with concealed piano door hinges and door swings as indicated. Equip with interior circuit-directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor coating. Design enclosures for recessed mounting or surface mounting, as shown on the drawings. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate and match properly with panelboards to be enclosed.
- E. Provide full piano type hinges on access door and full front cover.
- F. All panelboards shall be fully rated; series ratings will not be acceptable on this project.
- G. Digital Meters: Equal to Schneider Electric ION7550. Meter may be mounted in separate enclosure, if required.

#### 2.4 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

- A. Branch OCPDs: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- B. Lighting and Appliance Panelboards General: Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types and arrangements shown; with anti-burn solderless pressure type lug connectors approved for use with copper conductors; construct unit for connecting feeders at top of panel; equip with copper bus bars, full-sized neutral bar, with bolt-in type heavy-duty, quick-make, quick-break, single-pole circuit-breakers, with toggle handles that indicate when tripped. Provide suitable lugs on neutral bus for each outgoing feeder required; and provide bare uninsulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturer as panelboards, which mate and match properly with panelboards.
- C. Panelboard Enclosures: Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gage, minimum 16-gage thickness. Construct with multiple knockouts and wiring gutters. Provide fronts with piano hinge, and doors with flush locks and keys, all panelboard enclosures keyed alike, with concealed piano door hinges and door swings as indicated. Equip with interior circuit-directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor coating. Design enclosures for recessed or surface mounting, as shown on the drawings. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate and match properly with panelboards to be enclosed.
- D. Surface mounted panelboards except in the Mechanical and Electrical Rooms, shall be furnished with a factory designed full width wireway up to the ceiling and/or with a full width conduit skirt (cover) down to floor to cover all the exposed conduits. Both wireway and skirt shall be factory finished and provided with doors or removable front panels.
- E. Double-Width Panels: Where more than 42 poles are indicated or where otherwise indicated, provide two panelboards under separate covers with feed thru lugs, cabling matching the incoming feeder and conduits.
- F. Doors: In panel front, with concealed hinges. Secure with flush catch and tumbler lock, all keyed alike.
- G. Provide piano type hinges on access door and full front cover.

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- H. Molded-Case Circuit Breakers: Provide factory-assembled, molded-case circuit breakers of frame sizes, characteristics, and ratings including RMS symmetrical interrupting ratings indicated. Select breakers with permanent thermal and instantaneous magnetic trip, and with fault-current limiting protection, ampere ratings as indicated. Construct with over-center, trip-free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Construct breakers for mounting and operating in any physical position, and operating in an ambient temperature of 40 deg C. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated.
- I. Lighting and Appliance Panelboards shall be equal to Square D NQ or NF panelboards. Panelboards shall be rated minimum 22,000 Ampere R.M.S. Symmetrical, for the 120/208 Volt and 65,000A RMS 277/480V panelboards, or as shown in the drawings.
- J. All panelboards shall be fully rated; series ratings will not be acceptable on this project.
- K. All 50A and smaller circuit breakers installed in kitchen panels with the exception of breakers feeding lighting shall be equipped with ground fault protection.
- L. Accessories: Provide panelboard accessories and devices including, but not necessarily limited to, time-delay type fuses, ground-fault protection units, etc., as recommended by panelboard manufacturer for ratings and applications indicated.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION:

- A. Examine areas and conditions under which panelboards and enclosures are to be installed, and notify Contractor in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

#### 3.2 INSTALLATION OF PANELBOARDS:

- A. Install panelboards and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standards of Installation," and in compliance with recognized industry practices to ensure that products fulfill requirements.
- B. Ground Fault Protection: Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289, "Application Guide for Ground Fault Circuit Interrupters."
- C. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std's 486A and B.
- D. Fasten enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.
- E. Provide properly wired electrical connections for panelboards within enclosures.
- F. Fill out panelboard's circuit directory card upon completion of installation work.

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- G. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch empty conduits from panel into accessible ceiling space.

3.3 GROUNDING:

- A. Provide equipment grounding connections for panelboard enclosures as indicated. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounds.

3.4 FIELD QUALITY CONTROL:

- A. Prior to energization of electrical circuitry, check all accessible connections to manufacturer's tightening torque specifications.
- B. Prior to energization of panelboards, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.
- C. Prior to energization, check panelboards for electrical continuity of circuits, and for short-circuits.

3.5 ADJUSTING AND CLEANING:

- A. Adjust operating mechanisms for free mechanical movement.
- B. Touch-up scratched or marred surfaces to match original finishes.

3.6 DEMONSTRATION:

- A. Subsequent to wire and cable hook-ups, energize panelboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

End of Section 262416

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SECTION 262726 – WIRING DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.
- B. Requirements specified in all other sections of Division 26 apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Receptacles
  - 2. Plugs and Plug Connectors
  - 3. Snap Switches
  - 4. Ground Fault Circuit Interrupter Receptacles.
  - 5. Combination receptacles with USB charging.
  - 6. Wall Plates
- B. Related Sections: The following sections contain requirements that relate to this section:
  - 1. Division 26 Section "Electrical Identification" for requirements for legends to be engraved on wall plates.

1.3 SUBMITTALS

- A. Product data for each type of product specified.
- B. Samples of those products indicated for sample submission in Architect's comments on product data submittal. Include color and finish samples of device plates and other items per Architect's request.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with provisions of the following codes.
- B. NFPA 70 "National Electrical Code".
  - 1. UL and NEMA Compliance: Provide wiring devices which are listed and labeled by UL and comply with applicable UL and NEMA standards.

PART 2 - PRODUCTS

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2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Inc.
2. Leviton.
3. Pass and Seymour Inc.

2.2 WIRING DEVICES:

- A. General: Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards. Provide ivory color devices except as otherwise indicated. Verify color selections with Architect.
- B. Receptacles: Comply with UL 498 and NEMA WD 1. Where not otherwise indicated, provide 20A heavy duty, specification grade, tamper resistant receptacles. Provide receptacles equal to Hubbell Wiring Devices HBL5362TR series. Verify color selections with Architect.
- C. Where receptacles are wired to normal/emergency generator circuits, provide red colored receptacles, with ratings equal to above.
- D. Computer Receptacles – Surge Protection Device (SPD) Receptacles: NEMA 5-20R surge suppression receptacle with LED light, 240 joules/15000A per mode and tamper resistant. Provide SPD receptacle equal to Hubbell Wiring Devices HBL5360ISATR or approved equal with colors as selected by the Architect.
- E. Receptacles, Industrial Heavy Duty: Provide pin and sleeve design receptacles conforming to UL 498. Provide features indicated.
- F. Interior Ground-Fault Interrupter (GFI) Receptacles: Provide weather-resistant, tamper-resistant, "feed-thru" type ground-fault circuit interrupter, with integral commercial heavy-duty NEMA 5-20R duplex receptacles arranged to protect connected downstream receptacles on same circuit. Provide unit designed for installation in a 2-3/4 inch deep outlet box without adapter, grounding type, Class A, Group 1, per UL Standard 943. Provide receptacles equal to Hubbell Wiring Devices GFRTR20\*\* series, which comply with UL 943 for self-testing requirements, tamper resistant. Verify color selections with Architect.
- G. Exterior Ground-Fault Interrupter (GFI) Receptacles: Provide weather-resistant, tamper-resistant, "feed-thru" type ground-fault circuit interrupter, with integral commercial heavy-duty NEMA 5-20R duplex receptacles arranged to protect connected downstream receptacles on same circuit. Provide unit designed for installation in a 2-3/4 inch deep outlet box without adapter, grounding type, Class A, Group 1, per UL Standard 943. Provide receptacles equal to Hubbell Wiring Devices GFRTW20\*\* series, which comply with UL 943 for self-testing requirements, tamper resistant and weather resistant. Verify color selections with Architect.
- H. USB Charger Receptacles: Provide specification grade tamper-resistant NEMA 5-20R duplex receptacle with (2) integral USB ports; (1) USB Type A, providing 3 Amp, 5VDC, 2.0, complying with battery charging specification USB BC1.2, and (1) USB Type C, 5 Amp, 5VDC, 3.0 power delivery. USB charging shall be compatible with USB 2.0/3.0/3.1 devices, including Apple products. Provide USB receptacle equal to Hubbell Wiring Device-Kellems USB20ACPD\*\*. Verify color selections with

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Architect. For USB receptacles wired to emergency circuits, provide hospital grade RED USB receptacle equal to Hubbell Wiring Device-Kellems USB8300ACPDR.

- I. Plugs: 15-amperes, 125-volts, 3-wire, grounding, armored cap plugs, parallel blades with cord clamp, and 0.4 inch cord hole; match NEMA configuration with power source's.
- J. Plug Connectors: 15-amperes, 125-volts, bakelite-body armored connectors, 3-wire, grounding, parallel blades, double wipe contact, with cord clamp, and 0.4 inch cord hole, match NEMA configuration to mating plug's. Arrange as indicated.
- K. Snap Switches: quiet type AC switches as indicated in Table 2 in Part 3 below. Comply with UL 20 and NEMA WD1. Where not otherwise indicated, provide 20A industrial/institutional heavy duty grade switches.
  - 1. Standard Toggle: Provide Hubbell Wiring Device-Kellems 122\*-I (\* - single pole, double pole, three-way and four-way as required) series or approved equal with colors as selected by the Architect.
  - 2. Piloted Toggle: Provide Hubbell Wiring Device-Kellems HBL122\*PL (\* - single pole, three-way and four-way as required) or approved equal with colors as selected by the Architect.
  - 3. Standard Key: Hubbell Wiring Device-Kellems HBL122\*LI with HBL1209 key for locking (\* - single pole, double pole, three-way and four-way as required) series or approved equal with colors as selected by the Architect
- L. Plug-in strips: shall be of prewired, multi-outlet assembly, housed in steel enclosure, as shown on drawings. Outlets shall be of the grounding type as specified for receptacles and spaced and circuited as shown on drawings. Plug-in strips shall be Wiremold-Plugmold-series 2000, except otherwise noted on the drawings.

## 2.3 WIRING DEVICE ACCESSORIES

- A. Wall plates: single and combination, of types, sizes, and with ganging and cutouts as indicated. Provide plates which mate and match with wiring devices to which attached. Provide metal screws for securing plates to devices with screw heads colored to match finish of plates. Provide wall plate color to match wiring devices except as otherwise indicated. Provide wall plates with engraved legend where indicated. Conform to requirements of Section "Electrical Identification." Provide plates possessing the following additional construction features:
  - 1. Material and Finish: 0.04 inch thick, type 302 satin finished stainless steel, typical for all power, computer, telephone, CATV, etc. jacks in the project, except for where located in 4000 Series Wiremold.
  - 2. Exterior while-in-use covers: Equal to Hubbell WP26E aluminum cover, lockable.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF WIRING DEVICES AND ACCESSORIES:

- A. Install wiring devices and accessories as indicated, in accordance with manufacturer's written

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instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.

- B. Coordinate with other Work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other Work.
- C. Install wiring devices only in electrical boxes which are clean; free from building materials, dirt, and debris.
- D. Install wiring devices after wiring work is completed.
- E. Install wall plates after painting work is completed.
- F. Install clear, self adhesive labels on each receptacle with the panel source and circuit number. Refer to specification section "Electrical Identification" for additional details.
- G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A. Use properly scaled torque indicating hand tool.

### 3.2 PROTECTION

- A. Protect installed components from damage. Replace damaged items prior to final acceptance.

### 3.3 FIELD QUALITY CONTROL

- A. Testing: Prior to energizing circuits, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energizing, test wiring devices and demonstrate compliance with requirements, operating each operable device at least six times.
- B. Test ground fault interrupter operation with both local and remote fault simulations in accordance with manufacturer recommendations.

END OF SECTION 262726



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SECTION 262816 – 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 Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes individually mounted enclosed switches and circuit breakers used for the following:
  - 1. Feeder and branch-circuit protection.
  - 2. Motor and equipment disconnecting means.
- B. Related Sections include the following:
  - 1. Division 26 Section "Wiring Devices" for attachment plugs, receptacles, and toggle switches used for disconnecting means.

1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. RMS: Root mean square.
- C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

- A. Product Data: For each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each switch and circuit breaker.
  - 1. 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. Enclosure types and details for types other than NEMA 250, Type 1.
    - b. Current and voltage ratings.
    - c. Short-circuit current rating.
    - d. UL listing for series rating of installed devices.

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- e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- 2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
- C. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.
- D. Field Test Reports: Submit written test reports and include the following:
  - 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. Manufacturer's field service report.
- F. Maintenance Data: For enclosed switches and circuit breakers and for components to include in maintenance manuals specified in Division 01. In addition to requirements specified in Division 01 Section "Closeout Procedures," include the following:
  - 1. Routine maintenance requirements for components.
  - 2. Manufacturer's written instructions for testing and adjusting switches and circuit breakers.
  - 3. Time-current curves, including selectable ranges for each type of circuit breaker.

#### 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
  - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or 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 NEMA AB 1 and NEMA KS 1.
- D. Comply with NFPA 70.
- E. 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.

#### 1.6 PROJECT CONDITIONS

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- 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 (2000 m).

#### 1.7 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

#### 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. Spares: For the following:
    - a. Potential Transformer Fuses: One for every 10 installed; minimum of 3.
    - b. Control-Power Fuses: One for every 10 installed; minimum of 3.
    - c. Fuses and Fusible Devices for Fused Circuit Breakers: One for every 10 installed; minimum of 3.
    - d. Fuses for Fused Switches: One for every 10 installed; minimum of 3.
    - e. Fuses for Fused Power-Circuit Devices: One for every 10 installed; minimum of 3.
  - 2. Spare Indicating Lights: Six 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. Fusible Switches:
    - a. Eaton Corp.; Cutler-Hammer Products.
    - b. General Electric Co.; Electrical Distribution & Control Division.
    - c. Square D Co.
  - 2. Molded-Case Circuit Breakers:
    - a. Eaton Corp.; Cutler-Hammer Products.
    - b. General Electric Co.; Electrical Distribution & Control Division.
    - c. Square D Co.
  - 3. Combination Circuit Breaker and Ground-Fault Trip:

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- a. Eaton Corp.; Cutler-Hammer Products.
- b. General Electric Co.; Electrical Distribution & Control Division.
- c. Square D Co.

## 2.2 ENCLOSED SWITCHES

- A. Enclosed, Nonfusible Switch: NEMA KS 1, Type HD, with lockable handle.
- B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, with clips to accommodate specified fuses, lockable handle with two padlocks, and interlocked with cover in closed position.
- C. Elevators: Provide (2) NO/NC contacts where indicated and for all disconnects in an elevator machine room.

## 2.3 ENCLOSED CIRCUIT BREAKERS

- A. Molded-Case Circuit Breaker: NEMA AB 1, 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. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
    - 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.
  4. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.
  5. Molded-Case Switch: Molded-case circuit breaker without trip units.
  6. Shunt-Trip: Integral shunt-trip module within the Molded-case circuit breaker.
- B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
  1. Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.
  2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
  3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

## 2.4 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
  1. Outdoor Locations: NEMA 250, Type 3R.

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2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

## 2.5 FACTORY FINISHES

- A. Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard grey paint applied to factory-assembled and -tested enclosures before shipping.

## 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.
  1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

### 3.4 CONNECTIONS

- A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.
- B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.
- C. 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.

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3.5 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
  - 1. Test insulation resistance for each enclosed switch, circuit breaker, component, and control circuit.
  - 2. Test continuity of each line- and load-side circuit.
- B. Testing Agency: Engage a qualified independent testing agency to perform specified testing.
- C. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
  - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. 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.

3.6 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.7 CLEANING

- A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 262816

SECTION 263213 - 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. This Section includes packaged engine-generator sets for standby power supply with the following features:
  - 1. Generator quick-connects.
  - 2. Diesel engine.
  - 3. Unit-mounted cooling system.
  - 4. Unit-mounted control and monitoring.
  - 5. Performance requirements for sensitive loads.
  - 6. Sub-base tank.
  - 7. Outdoor sound attenuating enclosure.
- B. Base Bid:
  - 1. Life safety: Provide a 100A rated quick-connect manual transfer switch with a breaker and camlock connectors.
  - 2. Optional Standby: Provide an 800A generator quick-connect docking station with camlock connectors.
- C. Alternate Bid:
  - 1. Delete the 800A Optional Standby docking station and provide an optional standby 500kW diesel generator with a sub-base tank and sound attenuating housing.
  - 2. Life safety 100A rated quick-connect is not changed or modified for the alternate bid.

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 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.

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- 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 in the State of New Jersey. Calculate wind loading in accordance with the 2015 IBC considering generator base concrete slab, anchorage to the slab, and generator/sub-base tank/housing.
  - 3. Wiring Diagrams: Power, signal, and control wiring.
- C. Qualification Data: For installer and manufacturer.
- D. 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.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For packaged engine generators 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. 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.
- G. Warranty: Special warranty 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.
  - 1. Maintenance Proximity: Not more than two 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.



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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 99.
- J. Comply with NFPA 110 requirements for Level 1 emergency power supply system.
- K. Comply with UL 2200.
- L. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
- M. Noise Emission: Comply with applicable state and local government requirements for 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.

#### 1.6 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).

#### 1.7 COORDINATION

- A. Coordinate size and location of concrete foundations for package engine generators. Cast anchor-bolt inserts into bases.

#### 1.8 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.

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1. Warranty Period: 2 years from date of Substantial Completion or 1500 hours, whichever comes first.

#### 1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 24 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.

#### 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. 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 set each of lubricating oil, fuel, and combustion-air filters.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Generator Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Cummins Power Generation; Industrial Business Group.
  2. Kohler Power Systems / Rehlko (Basis of Design)
  3. MTU On-Site Energy.
  4. Caterpillar; Engine Div
- B. Docking Station / Quick-Connect Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Trystar (Basis of Design).
  2. Power Temp Systems
  3. PSI Control Solutions
  4. Or approved equal by the Engineer.

#### 2.2 DOCKING STATION

- A. Docking station for optional standby system shall be equal to Trystar GDS-1 series product.
- B. Enclosure
  1. NEMA 3R Rain-Tight Aluminum Enclosure
    - a. Pad-lockable front door shall include a hinged access plate at the bottom for entry of temporary cabling that prevents unauthorized tampering while in use.
    - b. NEMA 3R Integrity shall be maintained while temporary cabling is connected during use

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- c. Front and Side shall be accessible for maintenance
  - d. Top, Side, and Bottom shall be accessible for permanent cabling
- 2. Powder coat
- 3. Paint after fabrication shall be Hammer tone Gray
- C. Phase, Neutral, and Ground Busbar
  - 1. Material: Silver-plated Copper
  - 2. Equipment Ground Bus: bonded to box.
  - 3. Isolated Ground Bus: insulated from box.
  - 4. Ground Bus: 50% of phase size.
  - 5. Neutral Bus: Neutral bus rated 100 percent of phase bus.
- D. Temporary generator connectors shall be Camlok style mounted on gland plate.
  - 1. Camlok shall be 16 Series model and color coded according to system voltage requirements.
  - 2. Camlok connections shall be Bus Bar Style, Cabling or Double Set Screw is not acceptable
  - 3. Camlok connection shall be protected against accidental contact while not in use
- E. Permanent Connection shall be factory installed broad range set-screw mechanical type, located behind a physical barrier
- F. Short Circuit & Withstand Rating
  - 1. Shall be minimum 65 KAIC unless otherwise indicated on drawings
  - 2. Voltage & Amperage
    - a. 277/480V, 800A, 3-phase, 4-wire.
- G. Factory Installed Phase Rotation Monitor Device:
  - 1. Phase monitoring relay to be Siemens 3U4512-1AR20 or equal and factory installed
- H. Additional accessories shall be included as follows:
  - 1. Two Wire Auto Start
  - 2. Battery Charger Receptacle 20A GFCI 125V
  - 3. K#: Kirk Key Door Interlock
  - 4. Strip Heater & Thermostat

## 2.3 QUICK-CONNECT

- A. Generator quick-connect for life safety system shall be equal to Trystar TMTS-3 series.
- B. Standards:
  - 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.
  - 2. ETL/UL LISTED to 1008 Standards
  - 3. UL 50 LISTED
- C. Enclosure
  - 1. NEMA 3R Rain-Tight Aluminum Enclosure
    - a. Pad-lockable front door shall include a hinged access plate at the bottom for entry of temporary cabling that prevents unauthorized tampering while in use.
    - b. NEMA 3R Integrity shall be maintained while temporary cabling is connected during use
    - c. Front and Side shall be accessible for maintenance

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- d. Top, Side, and Bottom shall be accessible for permanent cabling
  - 2. Powder coat
    - 3. Paint after fabrication shall be Hammer tone Gray
  - D. Phase, Neutral, and Ground Busbar
    - 1. Material: Silver-plated Copper
    - 2. Equipment Ground Bus: bonded to box.
    - 3. Isolated Ground Bus: insulated from box.
    - 4. Ground Bus: 50% of phase size.
    - 5. Neutral Bus: Neutral bus rated 100 percent of phase bus.
  - E. Temporary generator and Load Bank connectors shall be Camlok style mounted on gland plate.
    - 1. Camlok shall be 16 Series model and color coded according to system voltage requirements.
    - 2. Camlok connections shall be Bus Bar Style, Cabling or Double Set Screw is not acceptable
    - 3. Camlok connection shall be protected against accidental contact while not in use
  - F. Permanent Connection shall be factory installed broad range set-screw mechanical type, located behind a physical barrier
  - G. Transfer Switch Configuration
    - 1. TMTS Docking Station shall have integrated Rotary Transfer Switch (MTS).
      - a. MTS shall have three positions – Utility/Permanent Line – OFF – Temporary Line
      - b. MTS shall be located behind pad lockable door to prevent any tampering by unauthorized personnel.
  - H. Short Circuit & Withstand Rating
    - 1. Shall be minimum 14KaIC 100-200Amp/25KaIC unless otherwise indicated on drawings
  - I. Voltage & Amperage
    - 1. 277/480V, 100A, 3-phase, 4-wire.
  - J. Factory Installed Phase Rotation Monitor Device:
    - 1. Phase monitoring relay to be Siemens 3U4512-1AR20 or equal and factory installed
  - K. Breaker Disconnects:
    - 1. 100A
    - 2. Must be UL 489 Listed Breaker
    - 3. Breakers shall be removable for service and maintenance
  - L. Additional accessories shall be included as follows:
    - 1. Two Wire Auto Start
    - 2. Battery Charger Receptacle 20A GFCI 125V
    - 3. K#: Kirk Key Door Interlock
    - 4. Strip Heater & Thermostat
- 2.4 ENGINE-GENERATOR SET
- A. Factory-assembled and -tested, engine-generator set model 500REOZJC unit with a 5M4027 alternator as manufactured by Kohler Power Systems / Rehlko or approved equal by one of the manufacturer's listed above.

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- B. Engine-generator set shall comply with EPA certification level NSPS Stationary Emergency Tier 2.
- C. 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.
- D. 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.
- 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.

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2.5 ENGINE

- A. Fuel: Fuel oil.
  - 1. Low-sulfur content to comply with EPA regulations.
- 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. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
  - 2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system, minimum 2500W at 208V, single phase. 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. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
  - 4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
  - 5. 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 noncollapsible under vacuum.
    - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

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- 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 23 feet (7 m) from exhaust discharge after installation is complete shall be 76 dBA or less.
  - 3. Exhaust piping and rain cap exposed outside of weatherproof housing shall be constructed of stainless steel.
- 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-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
  - 7. 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: Factory mounted inside of generator enclosure.

## 2.6 FUEL OIL STORAGE

- A. Comply with NFPA 30.
- B. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:
  - 1. Tank level indicator.

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2. Dual-wall sub-base tank.
3. Leak detection float switch.
4. Capacity: Fuel for minimum 36 hours' continuous operation at 100 percent rated power output. Minimum capacity of 1333 gallons.
5. Vandal-resistant fill cap.
6. Containment Provisions: Comply with requirements of authorities having jurisdiction.
7. Labels on sub-base tank (all 4 sides) showing the NFPA Hazard rating for the fuel oil.

## 2.7 CONTROL AND MONITORING

- A. Manual Starting System Sequence of Operation: When the mode control switch is in the manual position and the manual/run/stop switch is pressed, the generator set will start, bypassing time delay start. The control is configurable to include an idle period on manual start. If the generator set is running in the manual mode, pressing the run/stop switch will cause the generator set to shut down after a cool down at idle period.
- B. 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.
- C. 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. AMP402 controller with thermostatically controlled space heater or approved equal.
  2. 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.
  3. Current and Potential Transformers: Instrument accuracy class.
  4. Microprocessor based control operator display panel with (3) auxiliary relays or approved equal by one of the manufacturers listed above.
    - a. Relay outputs for genset running, common warning and common shutdown.
    - b. Alternator temperature alarm(s).
    - c. Supervised engine start generator controller equal to ASCO 5101 series system.
- D. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, 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.



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8. Ammeter-voltmeter, phase-selector switch(es).
9. Generator-voltage adjusting rheostat.
10. Fuel tank derangement alarm.
11. Fuel tank high-level shutdown of fuel supply alarm.
12. Generator overload.
13. Emergency shut-off button.
14. AC Metering Display – LED configured bar graphs for each function.
15. Control panel anti-condensation heater

- E. 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.
- F. 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.
- G. Remote serial annunciator panel (recessed).
- H. Remote emergency stop switch.

## 2.8 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker(s): Molded-case, electronic-trip type; 80 percent rated; complying with UL 489.
1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
  2. Trip Settings: Selected to coordinate with generator thermal damage curve.
  3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
  4. Mounting: Adjacent to or integrated with control and monitoring panel.
  5. Quantity: Provide quantity of breakers as shown on the contract drawings.

## 2.9 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.

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- 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.

#### 2.10 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 150 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
- B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
  - 1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
  - 2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.
- C. Convenience Outlets: Factory wired, GFCI. Arrange for external 120V-20A electrical connection.
- D. Integral maintenance LED lights with manual switch.
- E. Provide weather-protective, sound attenuated, Level 2 enclosure as manufactured by Kohler Power Systems / Relhko or approved equal by one of the manufacturers listed above.
  - 1. Sound Pressure Level Performance Requirements:
    - a. Maximum 76 dBA (A-weighted, average) at 7 meters around enclosure at full load.

#### 2.11 VIBRATION ISOLATION DEVICES

- A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
  - 1. Material: Natural rubber.
  - 2. Number of Layers: Two.

#### 2.12 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

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2.13 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.

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. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Install packaged engine generator with elastomeric isolator pads having a minimum deflection of 1 inch (25 mm) on 4-inch- (100-mm-) high concrete base. Secure sets to anchor bolts installed in concrete bases.
- D. 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.
  - 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.
- E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.
- F. Fuel Oil: Contractor shall provide a 100% fuel filled sub-base tank to the Owner after all testing has been completed, including load bank testing, operational testing and acceptance testing.

3.3 CONNECTIONS

- A. Connect engine exhaust pipe to engine with flexible connector.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

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- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.4 IDENTIFICATION

- A. Identify system components according to Division 26 Section "Identification for Electrical Systems."

### 3.5 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 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. 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.
- 3. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
- 4. 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.
- 5. 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.
- 6. 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, and compare measured levels with required values.
- 7. Load Bank Test: Provide 2 hour full 100% load resistive load bank test.

- C. Coordinate tests with tests for transfer switches and run them concurrently.

- D. 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.

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- E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- H. Remove and replace malfunctioning units and retest as specified above.
- I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- J. 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. Provide minimum 4 hours of on-site training for the Owner's personnel.

END OF SECTION 263213

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## SECTION 263600 – 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: 3-pole.

#### 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.
  - 1. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
- C. Qualification Data: For manufacturer.
- 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 eight hours from time of notification.

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- 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 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 99.
- H. Comply with NFPA 110.
- I. Comply with UL 1008 unless requirements of these Specifications are stricter.

#### 1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

### 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. ASCO Power Technologies, LP. (Basis of Design). No substitutions will be accepted.

#### 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.

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1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
2. ATS Switches on this project shall have a minimum withstand rating as follows. Provide required upstream fuses to meet this requirement.
  - a. 65,000A RMS for the Life Safety ATS
  - b. 65,000A RMS for the Optional Standby ATS
- 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: Solid neutral.
- H. Neutral Terminal: Fully rated.
- I. 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.
- J. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

## 2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment according to NFPA 110.
- B. Equal to ASCO 7000 Series automatic transfer switch with solid neutral and microprocessor based transfer control center.



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- C. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- D. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- E. 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.
- F. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- G. 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.
- 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. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
  - 10. Digital LCD screen power manager equal to ASCO Power Manager Xp. Features shall include ability to monitor and display:
    - a. Phase-to-Phase Voltages, Phase-to-Neutral Voltages
    - b. Phase and Neutral Currents

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- c. Frequency
  - d. Apparent Power (kVA)
  - e. Reactive Power (kVAR)
  - f. Real Power (kW)
  - g. Power Factor
- 11. Additional auxiliary contact sets to indicate switch position. Two sets are standard. Specify total number of sets if more are required.
  - 12. Two-pole, double-throw contacts operate when emergency source voltage is present at transfer switch terminals.
  - 13. Two-pole, double-throw contacts operate when normal source voltage is present at transfer switch terminals.
  - 14. Push-to-Test feature on all pilot light indicators.
  - 15. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum. ASCO 5101 supervised start module in each ATS.
  - 16. 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.
  - 17. 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.
  - 18. Load side external surge protection unit rated 100kA per phase with through door rotary disconnect switch.
    - a. Provide ASCO 460-277Y-10-T-C-E-1 surge protection device in NEMA 1 enclosure.
  - 19. Field installed (by Contractor) Custom LED phase indicating lights:
    - a. Refer to the drawings for requirements.

## 2.4 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, unless otherwise indicated.
- B. Identify components according to Division 26 Section "Identification for Electrical Systems."

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- 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."
- D. Connect each ATS to the security system to monitor the power is on/transferred to the generator.

### 3.3 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 installation, including connections, and to assist in testing.
  - 2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
  - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 4. 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.
  - 5. 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. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
    - f. 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.

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6. 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.
- B. Coordinate tests with tests of generator and run them concurrently.
- C. 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.
- D. 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 for a minimum of 2 hours 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 263600

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## SECTION 265119 – LED INTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes the following:
  - 1. Materials.
  - 2. Finishes.
  - 3. Luminaire support.
- B. Related Requirements:
  - 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relay panes, and architectural dimming systems and for LED dimming controls with dimming drivers specified in interior lighting Sections.
  - 2. Refer to Lighting Fixture Schedule on Contract Drawings.

#### 1.2 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, and housing.

#### 1.3 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. Include details of luminaire 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.

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- C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

#### 1.4 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.
- D. Sample warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.6 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period. Warranty Period: 5 years from date of Substantial Completion.
- B. The contractor shall warrant the completed lighting system wiring, equipment, lamps and drivers to be free from inherent mechanical and electrical defects for a period of two (2) years from the date of Substantial Completion. Refer to Division 1 specifications for definition of Substantial Completion.
- C. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion. It will not make any difference when equipment is ordered, delivered or installed, warranties will commence after the Architect issues his letter of "Substantial Completion."

### PART 2 - PRODUCTS

#### 2.1 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. Standards:
  - 1. ENERGY STAR certified.
  - 2. California Title 24 compliant.
  - 3. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
  - 4. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

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5. UL Listing: Listed for damp location.
6. Recessed luminaires shall comply with NEMA LE 4.
- C. CRI of minimum 80. CCT, as noted in Lighting Fixture Schedule.
- D. Rated lamp life of 50,000 hours to L70.
- E. Lamps dimmable from 100 percent to 10 percent of maximum light output in classrooms and common spaces, unless otherwise noted as dimmable from 100 percent to 1 percent.
- F. Internal driver, unless otherwise noted.
- G. Nominal Operating Voltage: As noted in Lighting Fixture Schedule.
1. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

## 2.2 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. [Retain "Acrylic" Subparagraph below if acrylic options in "Diffusers and Globes" Paragraph above are retained.
  2. Acrylic: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  3. Glass: Annealed crystal glass unless otherwise indicated.

## 2.3 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.

## 2.4 LUMINAIRE SUPPORT

- 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.

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- 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.
- F. Attach luminaires with a minimum of 4 points of support to the structure above.

## 2.5 LIGHTING FIXTURE SCHEDULE

- A. General: Various fixture types required are indicated below. Fixtures must comply with minimum requirements as stated herein. Review architectural drawings and specifications to verify ceiling types, modules, suspension systems appropriate to installation. In general, where so noted, substitutions for different type of fixture will be acceptable, based only on the alternate manufacturer listed for the specific fixture type, and on objective criteria as submitted in accordance with Instructions to the Bidders.
- B. A contractor submitted shop drawing for the lighting fixtures, stamped as Approved by the contractor, constitutes that the contractor has reviewed, coordinated and approved all information (number and quantity of switching devices, ceiling types, wiring schemes, etc.) on the Electrical and Architectural drawings.
- C. Refer to the contract drawings for the lighting fixture schedule.
  - 1. **Model numbers are shown for information only. The written description for each fixture shall supersede the model number. It shall be the contractor's responsibility to verify all model numbers. All final fixture finishes shall be selected by the Architect prior to fixture approval. Contractor shall bid on the most expensive finish available for each fixture, unless otherwise noted.**

## 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. Do not attach luminaires directly to gypsum board.



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G. 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 tubing or rod, 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.

H. 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, to the structure above.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

J. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

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 battery or generator power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 265119

SECTION 265561 - THEATRICAL LIGHTING AND 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 – SCOPE OF WORK

- A. This Section includes the following:
  - 1. Complete control panels to control the stage lighting.
  - 2. An electrical power distribution system to supply power to the new stage lighting distribution devices, a remote stage manager touch screen control station, manual remote control stations, new front of house stage light hanging positions with new branch circuits and data wiring (as necessary) in conduit to power outlets for all new stage and front of house stage lighting fixtures, and circuits connected to the house light fixtures.
- B. It is the responsibility of the successful contractor to furnish and install a completely functioning and working system, as if enumerated herein.
  - 1. The Electrical Contractor shall furnish all conduit, wire, connectors, hardware and other incidental items necessary for the complete and proper operation of the lighting control system.
  - 2. The Electrical Contractor shall coordinate all work described in this section with all other applicable plans and specifications.
  - 3. The Electrical Contractor shall utilize the services of a certified theatrical integrator to supply the materials called for and purchase the package from an authorized dealer for the materials required.
- C. Related Sections include the following:
  - 1. All other Sections in Division 26.

1.3 DEFINITIONS

- A. Stage Lighting: All stage and front of house stage light fixtures, receptacles, wiring, raceways, supports, etc. required to light the stage.
- B. Stage Lighting Control: All lighting controls, panels and control wiring and raceways required to control the stage lighting.
- C. House Lighting: Lighting fixtures, wiring and raceways required to light the Auditorium.
- D. House Lighting Control: All lighting controls, house dimming panel and wire required to control the house lighting.
- E. Work Lighting: Lighting Fixtures used during setup and maintenance of the theatre, typically lighting the stage when theatrical fixtures are turned off.

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#### 1.4 SUBMITTALS

- A. Manufacturer shall supply electronic copies of submittals as specified in Division 01. Submittals shall include:
  - 1. Stage and House dimming system complete system riser diagram(s) illustrating interconnection of system components, wiring requirements, back box sizes and any special installation considerations.
  - 2. Full set of printed technical data sheets for all control equipment, stage light fixtures and supports.
  - 3. Detailed set of dimmer schedules for the stage and house control panels.
  - 4. Detailed set of circuit and control schedules, including a complete list of all deviations from specifications.
  - 5. Manufacturer shall provide any additional information, including equipment demonstrations, as required by the engineer or specified to verify compliance with specifications.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer shall be one who has been continuously engaged in the manufacturer of lighting control equipment for a minimum of ten years. All dimmer and cabinet fabrication must take place in a U.S. manufacturing plant.
- B. The manufacturer shall have a toll free 24-hour hotline with a maximum response time of 15 minutes, 24 hours a day and 365 days a year. Manufacturers not able to supply this level of service shall not be allowed to bid the project.
- C. All equipment, where applicable standards have been established, shall be built to the standards of Underwriters Laboratories, Inc., the National Electric Code and the United States Institute for Theater Technology. Permanently installed power distribution equipment such as dimmer racks and distribution shall be UL and C-UL Listed, and/or CE marked (where applicable) and shall bear the appropriate labels. Portable equipment such as consoles and fixtures shall be UL and C-UL Listed, ETL Listed and/or CE marked (where applicable) and bear the appropriate labels.

#### 1.6 THEATRICAL INTEGRATOR

- A. All theatrical equipment shall be the responsibility of a single Contractor who shall own and operate a full-time, staffed shop for the fabrication, assembly, and installation of theatrical equipment, as required. This Contractor shall assume complete responsibility for the fabrication, transportation, and installation of the work in this section and shall hold the Owner, Architect, and all their employees and Consultants harmless for any costs for errors or omissions associated with the work of this section and any action arising there from.
- B. The contractor shall have at least ten (10) years' experience in the installation of similar equipment and systems for professional and educational theaters. The contractor shall provide references of at least (3) installations of comparable scope performed by the contractor, including location, description, name, address, and telephone numbers of the architects, consultants, and owners of contact persons for each. Comparable scope requires projects of including similar system topology and complexity of audio, video, lighting, & rigging systems.
- C. The contractor shall employ an ETCP Certified Rigger for rigging and pipe grid portions of the project.
- D. The contractor is a dealer or authorized agent for the major equipment listed.

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- E. Subject to the above requirements, work performed under this section shall be by one of the following approved Theatrical Contractors as subcontractor to a qualified electrical contractor:
  - 1. Starlite Productions, Moorestown, NJ TEL: 856-780-8000
  - 2. Illuminated Integration, Harrisburg, PA TEL: 717-996-4596
  - 3. M. Cramer & Associates, Philadelphia, PA TEL: 215-627-1225
  - 4. Barbizon Capitol, Alexandria, VA TEL: 703-750-3900
- F. Theatrical Integration responsibilities shall include but not be limited to:
  - 1. Provide light plot, focus chart and DMX address schedule of every performance lighting fixture with submittal information. Light plot shall be based on discussion with end user.
  - 2. Provide all low voltage data cable shown on system riser. (excludes fire alarm panic wiring)
  - 3. Provide theatrical distribution layout of all connector strips. Include line voltage connectors, low voltage outlets, circuit indications and spacing on all.
  - 4. Address and focus every performance lighting fixture.
  - 5. Commission entire theatrical and architectural control system(s) in the auditorium. Include programming of presets.
  - 6. Address house lighting fixtures connected to theatrical dimming system.
  - 7. Provide necessary programming provisions to integrate with AV system
- G. Electrical contractor responsibilities under this section shall include but not be limited to:
  - 1. Provide and install all line voltage wiring.
  - 2. Provide and install all conduit.
  - 3. Pulling of low voltage cables in conduit (Cable provided by theatrical integrator.)
  - 4. Provide and install house and work lighting.
  - 5. Provide installation of button stations and touchscreens, and all associated backboxes
  - 6. Coordination of scope with theatrical integrator
  - 7. No additional costs will be incurred arising from a misunderstanding of scope.

#### 1.7 ACCEPTABLE MANUFACTURERS

- A. The Standard of Design & Construction for Stage Lighting and Controls is: Electronic Theatre Controls, PO Box 620979 Middleton, WI 53562, Phone: 608-831-4116, Fax 608-836-1736.
- B. Alternate manufacturers shall be allowed to bid "or equal" materials. It is the sole responsibility of the contractor to ensure that any price quotations received and submittals made are for Stage lighting control systems and Stage Lighting Equipment that meet or exceed the base manufacturer's equipment which is the base of these specifications. Where this cannot be achieved the Alternate manufacturer shall list any discrepancies that their systems have from the items herein specified.
- C. Substitute manufacturers shall submit documentation for approval a minimum of 10 days prior to the date of bids.
- D. The supplier of this material shall be a dealer/integrator employing full time technicians certified by the factory to provide warranty service after providing the initial system commissioning and training.
- E. Additional materials are required from other manufactures. These factories include: TMB, The Light Source, and CantoUSA.

#### 1.8 WARRANTY

- A. Manufacturer shall warrant products under normal use and service to be free from defects in materials

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and workmanship for a period of two (2) years from the Date of Substantial Completion. Static fixtures shall have a five (5) year warranty on the LED array, and a ten (10) year warranty on the fixture body.

- B. Warranty shall cover repair or replacement of such parts determined defective upon inspection.
- C. Warranty does not cover any product or part of a product subject to accident, negligence, alteration, abuse or misuse. Warranty does not cover any accessories or parts not supplied by the manufacturer.
- D. Warranty shall not cover any labor expended or materials used to repair any equipment, without manufacturer's prior written authorization.

## PART 2 - PRODUCTS

### 2.1 DMX CONTROLLED MINI RELAY PANEL

- A. Product: Unison Foundry DMX Mini Control Panels by ETC, Inc. DMX controlled lighting. Fully rated 20 A relays and optional 0 to 10 V control per zone. Demand Response input for energy saving integration and UL 924 emergency lighting control bypass with power loss sense. Flush or surface mount. Locatable in air plenums tucked out of sight.
  - 1. Model UFMP4: 4-zone DMX Mini Panel.
    - a. Relays: 4. For switching for lighting and plug loads.
    - b. Dimming Outputs 0 to 10 V: 4. for LED drivers and fluorescent ballasts.
  - 2. Model UFMP8: 8-zone DMX Mini Panel.
    - a. Relays: 8. For switching for lighting and plug loads.
    - b. Dimming Outputs 0 to 10 V: 8. for LED drivers and fluorescent ballasts.
  - 3. Standards Compliance: cULus and UL 924 Listed. Rated for plenum installation.
    - a. Suitable for plug load control.
- B. Functional:
  - 1. Emergency Lighting Control: Per UL 924 via contact closure and power loss sense feed terminal.
  - 2. Demand Response Input: Provided by a power company can enforce a maximum level per circuit while active.
  - 3. Supports USITT DMX512-A; ANSI E1.11.
  - 4. Supports RDM; ANSI E1.20.
- C. Mechanical:
  - 1. Finish: Fine-textured, black powder coat.
  - 2. Mounting: Wall, Flush-mount. Rated for installation in plenum air space.
  - 3. Mounting: Wall, Surface-mount. Rated for installation in plenum air space.
  - 4. Voltage Divider: Allows for separation of normal and emergency circuits in a single controller were allowed by local codes.
- D. Electrical:
  - 1. Power Input: 100 to 277 VAC, 50/60 Hz per circuit with support for pass thru to multiple circuits.
  - 2. Single Phase Sense Feed Input: 100 to 277 VAC.
  - 3. Supports 120 VAC and 277 VAC circuits within the same panel.
  - 4. Fully-Rated Bi-State Latching Relay per Output: 20 A.
  - 5. Control Rated: 0 to 10 VDC for up to 100 mA sink per output.

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- a. Outputs 0 to 10 V: Fully isolated from ground to 2500 V RMS.
6. Demand Response input supports Normally Open (NO) operation.
7. UL 924 contact closure input supports normally open (NO) or normally closed (NC) operation.
8. Onboard status indicators for controller power, DMX signal, Demand Response input, and UL 924 emergency lighting control.
9. Slide Switch Configuration For:
  - a. UL 924 operation; NO/NC.
  - b. UL 924 inclusion per circuit; On/Off.
10. Relays: Mechanically held.
11. DMX Input Port:
  - a. Integrated DMX/RDM termination.
12. Thermal: Operating range limits.
  - a. Temperature: 32 to 122 degrees F (0 to 50 degrees C).
  - b. Humidity Non-Condensing: 5 to 95 percent.

## 2.2 ARCHITECTURAL CONTROLS

### A. Stations: Shall be the ETC Unison Echo Inspire Series

1. Standards Compliance: cULus Listed. CE Certified.
2. Functional:
  - a. Button and Fader Functions: preset activation/ deactivation, record, raise, lower, zone on/off control and room combine.
  - b. Blue button illumination for active status.
  - c. Amber or no button illumination for inactive status.
  - d. Fader halo-illumination displays actual output level.
  - e. Zone or preset control from any station with real-time user toggle.
3. Mechanical:
  - a. Enclosed electronics assembly and faceplate included.
  - b. No visible means of attachment.
  - c. Flush-mount in industry-standard backbox, RACO 690 or equivalent.
  - d. Surface-mount backboxes available from manufacturer.
  - e. Constructed of injection-molded, ABS plastic.
  - f. Cantilevered switch arrays with removable button caps.
  - g. User configurable legends on each button or use standard legends that come with each station. Field configurable without the use of tools.
  - h. Integral LED response indicator for each button with indication of active(blue) and inactive(amber or off) state.
4. Electrical:
  - a. Connect via EchoConnect control network. Low-voltage Class 2 wiring.
  - b. Topology-free wiring over Belden 8471 and one No. 14 ESD drain wire.
  - c. Control Wiring: 1640 ft (500 m).
  - d. Belden 1583A or equivalent Ethernet control wire when used with Cat5 termination accessories.
  - e. Control Wiring: 1000 ft (300 m) using CAT5.
  - f. Wiring: Bus, loop, homerun, or any combination of these.
  - g. Station Terminations: Removable connectors.
  - h. Operating Temperature Range: 32-122 degrees F (0-50 degrees C).
  - i. Relevant Humidity Non-Condensing: 5-95 percent maximum.

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- B. Power Modules:
  - 1. Product: Unison EchoConnect Station Power Supply by ETC Inc.
    - a. Model E-SPS-DIN: DIN Rail Mount Station Power Supply with 24 V Aux.
  - 2. Convert Input Power into Class II Low-Voltage Power with data line. Energize control stations, zone controllers, time clock, and devices for multi-scene lighting control.
  - 3. Electrical:
    - a. Utilize line-voltage power supplied by contractor, terminated inside dimming enclosure, or power supply.
    - b. EchoConnect Communications with Remote Devices: Control stations, zone controllers, time clock stations and other devices.
    - c. EchoConnect Network: Low-voltage Class II twisted pair wiring, type Belden 8471 (unshielded) or Belden 8719 (shielded). And one No 14 AWG drain wire for system not using grounded metal conduit.
      - 1) Topology Free Network: Bus, loop, home run, star, or any combination.
      - 2) Control Bus Wiring: Permit total wire runs of 1640 ft (500 m)
      - 3) Wiring Between Stations: Not to exceed 1313 ft (400 m).
      - 4) CAT5 Wiring: For systems not requiring topology free infrastructure or EchoConnect bus lengths not more than 1000 ft (305 m).
  - 4. Capacity: Power for up to 16 control stations, zone controllers, time clock stations and other devices, and/or provide 24 V Auxiliary Power to devices that require it.
- C. Touchscreen Control Stations to be Unison Echo EchoTouch Controller Mk2 by ETC, Inc. Controls 512 DMX addresses on up to 80 control zones.
  - 1. Standards Compliance: cULus Listed and CE Compliant. FCC Compliant.
  - 2. Operation: Graphic buttons, faders, and images on at least 7 user programmable default and fully graphical control pages.
  - 3. Touchscreen: Integrated with ETC Unison Echo Controls.
    - a. Seven-inch, backlit liquid crystal display. Resolution: 800 by 400 pixels minimum, with capacitive multi-touch interface.
    - b. Bezels: Cast aluminum. Finish: Fine texture powder coat.
      - 1) Four colors: Cream, Gray, Black, or Signal White.
      - 2) No visible means of attachment.
  - 4. Supports Surface, Flush and Rack Mounting.
    - 1) Flush-mount: To industry standard 3 gang back box.
    - 2) Surface Back Box Dimensions (WxHxD): 7.35 x 4.88 x 3.5 inches 187 x 124 x 3.5 89 mm) available from Manufacturer.
    - 3) Rack Mounting: Fit in standard 19 inch (483 mm) racks, no taller than 3 EIA rack units.
  - 5. Electrical:
    - a. RJ45 Ethernet Port: Connection to lighting system and Power over Ethernet.
    - b. Control Wiring: EchoConnect Connection terminals.
      - 1) Low-voltage, Class II unshielded twisted pair, type Belden 8471 and one No. 14 ESD drain wire; when not installed in grounded metal conduit.
      - 2) Topology free. Point-to-point, bus, loop, home run or any combination.
    - c. Power Input, Non-PoE: Two, No. 16 AWG stranded wires for 24 VDC.
    - d. Typical Power Draw: 400 mA.
    - e. Firmware Maintenance: USB type A connector.
    - f. Network:
      - 1) Network Cabling: Category 5 or better. Conform to TIA-568A/B. Installed by qualified network installers.
    - g. Functional System:
      - 1) Presets: 64. Contained in non-volatile electronic memory.
      - 2) Internal sequences: 4. Record user-selected zone levels.

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- 3) Touchscreen: Equipped with on-board help system.
  - 4) Software upgrades: Via USB drive only.
  - 5) USB Port: Show data to be saved for archival or transfer to other consoles or a personal computer.
- h. Patching: Facilities for dimmers and multi-parameter devices via built in library of fixture definitions.
  - 1) Fixture Library: Updated via software based updates. Create custom fixture definitions using offline application.
  - 2) Touchscreen: Support patching, address setting, and mode changes using Remote Device Management (RDM) on local DMX/RDM port.
- i. Playback Control: Customizable zone display. Rearrange graphical representations for control channels to mimic fixture positions in installation.
  - 1) Seven user customizable interactive pages.
  - 2) Color and white pickers.
  - 3) Touch-based parameter controls with reference-based palettes.
  - 4) Virtual level wheel.
- j. Layout and Configuration: View and modify layout of user pages.
  - 1) Add, remove, or edit the following items: Preset buttons. Off buttons. Sequence buttons. Zone and space modifier buttons. Space combine buttons. Zone fader.
  - 2) Three Options for Inactivity: Dim screen to level. Turn screen off. Display user chosen inactivity image.
  - 3) Multiple Configurations: May be stored within an LCD Station.
- 6. Time Clock: Touchscreen built-in astronomical and real time event engine allowing presets and sequences activation.
  - a. Support 80 Events: Astronomical, real-time, and manual control events in 16 control spaces.
  - b. Timed Events: Programmable via Touchscreen.
    - 1) Assigned to day types.
    - 2) Day Types: everyday, weekday, weekend, and day of week.
    - 3) Activation: Based on sunrise, sunset, time of day, opened and closed events and configurable state based engine.
    - 4) Compensate for regions using daylight saving time.
    - 5) Assignment to events via time clock user interface.
    - 6) Resumes automatically after power loss.
  - c. Support timed event hold. Timed Event Hold: Meet CA Title 24 requirements.
- 7. External Control: Control of lighting system through built-in UDP integration.
  - a. Supports full control of lighting system using UDP strings.
    - 1) Security settings to limit incoming control strings to subscribers-only.
  - b. Supports up to two subscribers for receiving status messages.
  - c. Control and status integrations from 3rd party systems include:
    - 1) Zones.
    - 2) Channels.
    - 3) Presets.
    - 4) Spaces.
    - 5) Sequences.
    - 6) Lockout.

## 2.3 LIGHTING NETWORK

### A. General



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1. The Electronic Theatre Controls Net3 network shall provide data distribution over TCP/IP Ethernet networks. Data shall be layer 3 routable. Systems using proprietary formats or formats other than 10/100/1000 Mbit wired Ethernet or non-layer 3 routable networks shall not be accepted.
2. Connections shall be made between consoles, face panels, architectural processors, dimmers, Net3 Gateways, and computers over standard Ethernet distribution systems using 100BaseT, 100BaseFL, or greater wiring. All installations shall conform to established Ethernet wiring practice, and installation shall be performed by contractors qualified to do this type of work. All wiring shall be tested at Category 5e or higher for full bandwidth operation to the appropriate IEEE standard.
3. The Lighting Control system must be supplied by a single manufacturer and must have seamless integration over Ethernet between the Entertainment and Architectural lighting control.

B. Capacities

1. The network shall support DMX routing, patching, and prioritization for up to 63,399 universes (32,767,488 DMX addresses). Each address may be input or output from any port on any DMX gateway in the system. DMX input, routing and output shall be specifically supported on the system from multiple sources and locations up to the maximum number of gateways supported by the Ethernet topology.
2. The network shall support multiple network hosts including consoles, gateways, dimming racks, computers, file servers, printers, and architectural control processors with discrete command lines and control. The lighting network shall support multiple venues within a system and discrete systems on the same network.

C. System Configuration and Monitoring

1. Network device configuration shall be via Net3 Gateway Configuration Editor (GCE) software and/or ANSI E1.17 Architecture for Control Networks (ACN).
2. Patch addresses shall support viewing and manipulation via ANSI E1.17 ACN.
  - a. The system shall permit complete user flexibility allowing the system operator to patch each DMX input address to any ANSI E1.31 streaming ACN address, and DMX output to span streaming ACN universes.
  - b. The lighting system shall support assignment of DMX offsets, truncation of DMX universes, and provide choice of DMX port prioritization.
  - c. The lighting system shall support the DD start code extension to ANSI E1.31 which provides priority per address such that multiple control sources can share universes with discrete control per address.
  - d. Lighting systems that do not support the above-mentioned address patching capabilities shall not be suitable.
3. The system shall allow assignable labels for all network devices to allow easy identification by system users.
4. Each network device shall have a discrete and unique IP address provided automatically by the software. The user may edit this IP address. Systems that do not support automated IP allocation with IP collision avoidance, and systems that do not allow complete reconfiguration of the above-mentioned features over ANSI E1.17 ACN shall not be acceptable.
5. All configuration data for each network device shall be held at the device and system operation shall not require continuous on-line operation of the network configuration software.
6. Lighting console operators shall be able to backup the network configurations in the lighting control console. In the event of a network device failure, the operator shall be able to apply the configuration of the failed device to a replacement device of the same type without manually reentering settings. Systems that do not support configuration backup as described above shall not be accepted.
7. The Net3 network shall allow multiple DMX input sources to be prioritized on the same universe as network native sources using E1.31 Streaming ACN prioritization. Multiple DMX inputs may

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be assigned to the same streaming ACN address (this provides multi-source control for a particular address). Likewise, the system shall support E1.31 prioritization of multiple simultaneous network sources. Systems that cannot prioritize multiple DMX inputs and multiple native network sources on a network shall not be deemed suitable.

8. The lighting network shall allow each DMX input address to be assigned a priority on the network allowing each DMX control level coming into the system to participate in full arbitration. Addresses with the highest priority shall have control, with lower priority addresses being ignored. Addresses assigned the same numeric priority, between 1 and 200, shall respond in highest level takes precedence (HTP) manner. The network shall require a valid DMX signal present at the input to initiate prioritization. Systems that do not allow for prioritized HTP for DMX inputs to the network shall not be allowed.

D. Operational Features

1. Duplicate outputs of DMX data (DMX splitter) and discrete outputs shall be fully supported.
2. Merging of multiple DMX input sources on a single gateway without gateway with DMX output on the same gateway shall be supported without connection to the network. The gateway shall support assignment of priority to each input source independently

2.4 MISCELLANEOUS NETWORK EQUIPMENT

A. Network Control Equipment, supply the following as needed:

1. DIN Enclosure sized per job needs
2. DIN mount network switch
3. ETC Response Gateways as detailed on system riser
4. DMX OPTO Splitters as required

2.5 LIGHTING CONTROL CONSOLE AND ACCESSORIES

- A. No Lighting Console to be provided with this contract.

2.6 POWER DISTRIBUTION – CONNECTOR STRIPS: FOR TORMENTORS & ON-STAGE ELECTRICS

A. Connector strips shall be the MEGABATTEN as manufactured by The Light Source

1. Connector strips shall be formed from schedule 80 aluminum pipe, painted in black or white
2. 20A Edison and 5-pin XLR receptacles shall be spaced every 16"
3. Connector strip shall handle up to (6) 20A, 120V circuits
4. Connector strip shall be ETL listed to the UL1573 Stage and Studio Standard as a connector strip.

2.7 POWER DISTRIBUTION – OUTLET BOXES

A. General

1. Connectors shall be available as 20A, 50A and 100A grounded stage pin, 20A twist lock and 20A "U" ground (dual rated "T-slot"); other connectors shall be available as specified
2. Outlet boxes shall be supplied with appropriate brackets and hardware for mounting as shown on the drawings
3. A low voltage distribution system shall be available to incorporate DMX, Ethernet or other protocols as specified in the power distribution box

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- a. A voltage barrier shall be used to separate the low voltage wiring for the electrical circuits
4. Power distribution equipment shall be listed by a nationally recognized test lab (NRTL)
5. Circuits shall be labeled with 1.25" lettering

## 2.8 FIXTURES & ACCESSORIES

### A. ELLIPSOIDAL FIXTURES

1. Basis of Design: Source 4WRD II (Watt Reduction Device) Engine as manufactured by ETC Inc. A replacement for a Source Four burner. Converts the HPL source to a white-light LED and provides a significant reduction in power consumption. Theatrically dimmable via DMX or line dimmable, with a traditional LED curve, to allow flexibility for your installation.
2. Standards Compliance:
  - a. Complete Luminaire: UL 1573 and CSA C22.2 No. 166.
  - b. Retrofit Kit: UL 1598C and CSA TIL B79-A.
  - c. Compliance: CE.
3. Source 4WRD II, Retrofit Kit, 120 V with Fixture Body.
4. Source:
  - a. LED Details: S4WRD II LED.
  - b. Max Lumens: 3200 K: 11430. 3200 K Gallery: 9716. Daylight Gallery: 10333.
  - c. Lumens per Watt:
    - 1) 120 V: 3200 K: 76.2. 3200 K Gallery: 64.8. Daylight Gallery: 68.9.
  - d. L70 Rating: Greater than 45,000 hours.
5. Color:
  - a. Colors Used: Warm or Cool White.
  - b. Color Temperature Range: 3200 K 80+ or 90+ CRI, 5900 K 90+ CRI.
  - c. Calibrated Array: No.
  - d. Red Shift: No.
6. Optical:
  - a. Field Angle Range: Swappable lens tubes between 5 to 90 degrees.
  - b. Gate Size: 79 mm.
  - c. Aperture Size: Lens dependent.
  - d. Pattern Projection: Yes.
  - e. Camera Flicker Control/Hz Range: No, not PWM dimmed.
7. Control:
  - a. Input Method: DMX Control per line dimmed. Protocols: DMX/RDM via RJ45.
  - b. Modes (Footprint): 1 Channel (Intensity) for DMX.
  - c. RDM Configuration: Yes.
  - d. User Interface Type: 7-segment address display, local level control via UI.
  - e. Local Control: Yes.
  - f. Onboard Presets: No. Onboard Sequences: No. Onboard Effects: No.
  - g. Fixture to Fixture Control: No.
8. Electrical:
  - a. Voltage: 120 VAC: 114 to 125 V, 60 Hz. 230 VAC: 209 to 252 V, 50 Hz.
  - b. Input Method:

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- 1) 120 V: Hardwired, 39 inch cord, Edison plug.
  - c. Inrush First Half-Cycle: 30 A at 120 V. 12 A at 230 V,
  - d. Fixtures per Circuit:
    - 1) 120 V: 14, 20 A switched circuit, R20 module or similar.
  - e. Wattage (Typical/Standby): 1505 / 1.2 at 120 V. 175 / 3.7 at 230 V.
  - f. Current Draw: 1.26 A at 120 V. 0.75 A at 230 V
9. Thermal: Operating Temperature: 41 to 104 degrees F.
- a. Fan: Yes, Not controllable.
  - b. Droop Compensation: No.
  - c. dB Range: 28 dBa. Average at 39 inches.
  - d. BTUs/hour: 120 VAC: 529. 230 VAC: 597.
10. Physical: IP Rating: IP-20 indoor only.
- a. Materials: Cast aluminum. Colors: Black, white, silver, or custom.
  - b. Mounting Options: Yoke.
  - c. Included Accessories: 4WRD mounting post.

11. Provide fixtures as noted on system riser.

B. PAR Fixtures

1. Basis of Design: ColorSource PAR Jr. as manufactured by ETC Inc. An affordable high quality wash fixture. Uses RGB-L or RGI-L color system.
2. Standards Compliance:
- a. Listed: cETLus, UL 1598, CSA C22.2 No. 250.
  - b. Compliance: CE and EAC.
3. Source:
- a. LED Details: 16 Lumileds LUXEON C LEDs.
  - b. Max Lumens: PAR jr: 2,290. PAR DB: 2,061.
  - c. Lumens per Watt: PAR: 31.8. PAR DB: 28.6.
  - d. L70 rating: 54,000 hours.
4. Color:
- a. Calibrated Array: Yes.
  - b. Red Shift: No.
5. Optical:
- a. Beam Angle Range: 15.3 degrees. (secondary lenses available)
  - b. Gate Size: N/A.
  - c. Aperture Size: 5 inches.
  - d. Pattern Projection: No.
  - e. Pattern Size: N/A.
  - f. Camera Flicker Control/Hz Range: Default: 1,200 Hz. RDM: 25,000 Hz.
6. Control:
- a. Input Method: DMX-512 via 5-pin XLR connector. Protocols: DMX512, RDM.
  - b. RDM Configuration: Yes.
  - c. User Interface Type: 7-segment 3 button interface.
  - d. Local Control: Yes.
  - e. Onboard Presets: Yes, 12. Onboard Sequences: Yes, 5. Onboard Effects: No.

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- f. Fixture-to-Fixture Control: Yes.
  - g. 15-bit virtual dimming engine.
- 7. Electrical:
  - a. Voltage: 100 to 240 VAC, 50 to 60 Hz. Input Method: PowerCON in and thru.
  - b. Inrush First Half-Cycle:
  - c. 14.5 A at 120 V. 28.7 A at 240 V.
- 8. Thermal: Operating Temperature: 32 to 104 degrees F.
  - a. Fan: No.
  - b. Droop Compensation: Yes.
  - c. BTUs/hour: 246.
- 9. Physical: IP Rating: IP-20.
  - a. Materials: ABS Plastic. Colors: Black or white.
  - b. Mounting Options: Yoke or floor stand.
  - c. Included Accessories: Power cable and hanging yoke.
  - d. Seven-segment, three-button Interface.
- 10. Provide fixtures as noted on system riser

C. General Fixture Accessories and Spare Equipment

- 1. For each fixture provide a 5' DMX cable from TMB or equal
- 2. Provide Spare DMX cables from TMB to consist of:
  - a. (2) 10' DMX Cable
  - b. (2) 25' DMX Cable
  - c. (1) 50' DMX Cable
- 3. DMX and Extension Cables shall be labeled at each end with cable length.

2.9 RIGGING COMPONENTS

- A. Pipe Clamps: Malleable iron, suitable for clamping luminaires or items to pipe from  $\frac{3}{4}$  to 2 inches in OD. Arranged for horizontal rotation of yoke for aiming; equipped with T-bolt to lock alignment.
- B. Safety Cables: Black, Heavy-duty, flexible steel; 30-inch (762-mm) nominal length, with spring clip at one end and steel ring at the other end. Manufactured by The Light Source.
- C. Cable Grips: Galvanized steel; basket-weave type for supporting stage cables.
- D. All rigging performed under this contract must comply with ESTA and ANSI standards for rigging.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.

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- 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 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 indicated in the specifications.

### 3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Set permanently mounted items level, plumb, and square with ceilings and walls.
- C. Comply with mounting and anchoring requirements specified in Section 26 05 29 "Hangers and Supports for Electrical Systems".
- D. Mount and connect luminaires, and install and connect distribution devices.
  - 1. If arrangement is not indicated, install so each luminaire, dimmer, house lighting circuit, control channel, and outlet circuit can be operated, and complete system demonstrated, in all operating modes.
  - 2. Install safety cables secured to stage rigging or gridiron for all pipe-mounted electrical luminaires and equipment.
- E. It shall be the responsibility of the Electrical Contractor to receive and store the necessary materials and equipment for installation of the theatrical lighting system. It is the intent of these specifications and plans to include everything required for proper and complete installation and operation of the dimming system, even though every item may not be specifically mentioned. The contractor shall deliver on a timely basis to other trades any equipment that must be installed during construction.
- F. The electrical contractor shall be responsible for field measurements and coordinating physical size of all equipment with the architectural requirements of the spaces into which they are to be installed.
- G. The electrical contractor shall install all lighting control and dimming equipment in accordance with manufacturer's approved shop drawings.
- H. All branch load circuits shall be live tested before connecting the loads to the dimmer system load terminals.

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- I. All exposed conduit on stage and terminating at theatrical plug boxes shall be black.

### 3.4 WIRING

#### A. Power Wiring:

- 1. Install wiring as specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for hardwired connections. Install wiring in raceways except cable and plug connections. Install cable strain relief device on power and control cable drops.
- 2. Install power wiring with a separate neutral for each output circuit and for each house and stage lighting circuit.

#### B. Signaling, Remote Control, and Power-Limited Circuits:

- 1. Install wiring in raceways except cable and plug connection. Alternatively, composite MC Cable with line voltage conductors and twisted shielded wiring may be used (AFC Cable Systems-Luminary Cable)
- 2. Comply with the following unless otherwise indicated:
  - a. Size conductors according to lighting control device manufacturer's written instructions.
  - b. Select cable insulation, shielding, drain wire, and jacket complying with lighting control device manufacturer's written instructions.
  - c. Install circuits to eliminate RFI and electromagnetic interference.
- 3. Remote-control circuits associated with emergency lighting control shall be installed complying with Class 1 circuit standards in NFPA 70.

#### C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points.

#### D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes and in terminal cabinets and equipment enclosures.

#### E. Remove wall plates and protect devices and assemblies during painting.

#### F. Support luminaires, distribution components, and accessories as specified in Section 26 05 29 "Hangers and Supports for Electrical Systems." Equip all pipe-mounted equipment with safety cables that are secured to supporting pipe.

#### G. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.5 IDENTIFICATION

#### A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

#### B. Label each luminaire, lighting outlet, distribution device, and dimmer module with unique designation. Labels on elevated components shall be readable from the floor.

### 3.6 FIELD QUALITY CONTROL

#### A. Manufacturer's Field Service: Engage a factory-authorized service representative to test, inspect, and adjust components, assemblies, and equipment installations, including connections.

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- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Visual and Mechanical Tests and Inspections:
  - 2. Inspect each theatrical luminaire, outlet, module, and control device for defects, finish failure, corrosion, physical damage, labeling by and NRTL, and nameplate.
  - 3. Perform operational test on mechanical parts and operable devices according to manufacturer's instructions.
  - 4. Check tightness of electrical connection with torque wrench.
  - 5. Verify proper protective device settings, fuse types, and ratings.
  - 6. Record results of tests and inspections and remit to engineering team.
- C. Electrical Tests: Perform tests according to manufacturer's written instructions
  - 1. Continuity tests of circuits
  - 2. Operational test: connect each theatrical fixture to an outlet and DMX controller. Perform burn-in testing for 8-hours prior to installation of fixture.
- D. Stage lighting will be considered defective if it does not pass tests and inspections.

### 3.7 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 (2) visits during normal occupancy hours for this purpose. This can include but shall not be limited to:
  - 1. Re-focusing of theatrical fixtures
  - 2. Additional training
  - 3. Re-recording of presets
- B. Software updates released within 12 months of date of Substantial Completion for any device in the system shall be provided.
- C. It shall be the responsibility of the Theatrical Integrator to follow up with an owner contact at 6 and 12 months following the date of Substantial Completion to ensure adjustments are made if needed.

### 3.8 MANUFACTURER SERVICES

- A. Upon completion of the installation, including testing of load circuits, the contractor shall notify the dimming system manufacturer that the system is available for formal checkout.
- B. Notification shall be provided in writing, three weeks prior to the time that factory-trained personnel are needed on the job site.
- C. No power is to be applied to the dimming system unless specifically authorized by written instructions from the manufacturer.
- D. The electrical contractor shall be liable for any return visits by the factory engineer as a result of incomplete or incorrect wiring.
- E. Theatrical integrator to provide one (1) day of integration with AV systems contractor. It is the responsibility of the theatrical integrator to coordinate with the AV systems contractor to schedule.
  - 1. Integration shall include but not be limited to:



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- a. Preset activation/deactivation
- b. System On/Off functionality
- c. Recoding of Presets from Console Input
- d. Macro activation
- e. Color Selection

### 3.9 AS BUILT DOCUMENTATION

- A. As-built documentation specific to the theatrical lighting and control system shall be provided on 11x17 paper and PDF to the owner and engineering team within 1 month of date of Substantial Completion. A copy shall also be placed inside the equipment rack.

### 3.10 OPERATING AND MAINTENANCE MANUALS

- A. Operating and Maintenance manuals shall be provided in a binder and PDF to the owner.

### 3.11 INSTRUCTION OF OWNERS PERSONNEL

- A. Upon completion of the formal check-out, the theatrical integrator shall train owner's representatives. Training shall be conducted in one (1) four-hour session.
- B. Training shall cover but not be limited to:
  - 1. Maintenance of system
  - 2. Operation of system without a console
  - 3. Console operations (Basic)
  - 4. Console operations (Advanced)
- C. Theatrical integrator shall provide contact information to owner's representatives.
- D. Owner shall be permitted to record audio and video during the instruction.

END OF SECTION 265561

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SECTION 265619 – LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division - 1 Specification Section, apply to work of this Section.
- B. All the requirements of all the Division 26 Sections apply to this Section.

1.2 SUMMARY:

- A. Extent, location, and details of lighting fixture work are indicated on drawings.
- B. Types of lighting fixtures in this section include the following:
  - 1. LED

1.3 SUBMITTALS:

- A. General: Submit the following in accordance with conditions of Contract and Division 1 Specification Sections.
- B. Product Data: Submit manufacturer's product data and installation instructions on each type interior and exterior building lighting fixture and component.
- C. Shop Drawings: Submit layout drawings of lighting fixtures and their spatial relationship to each other. In addition, submit fixture shop drawings in booklet form with separate sheet for each fixture, assembled in "laminar type" alphabetical or numerical order, with proposed fixture and accessories clearly indicated on each sheet. Drawings shall indicate complete details of fixture, including manufacturer's catalog numbers for sockets, ballasts, lamps, lightshields, lenses, metal gauges, type of wiring, finish color and texture.
- D. Wiring Diagrams: Submit wiring diagrams for auditorium lighting showing connections to electrical power panels, switches, dimmers, controllers, and feeders. Differentiate between portions of wiring which are manufacturer-installed and portions which are field-installed.
- E. A contractor submitted shop drawing for the lighting fixtures, stamped as Approved by the contractor, constitutes that the contractor has reviewed, coordinated and approved all information (number and quantity of switching devices, wiring schemes, etc.) on the Electrical and Architectural drawings.

1.4 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of lighting fixtures of sizes, types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

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B. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Articles 220, 410, and 510 as applicable to installation, and construction of building lighting fixtures.
2. NEMA Compliance: Comply with applicable requirements of NEMA Stds Pub/No.'s LE 1 and LE 2 pertaining to lighting equipment.
3. IES Compliance.
4. UL Compliance: Comply with UL standards, including UL 486A and B, pertaining to lighting fixtures. Provide lighting fixtures and components which are UL-listed and labeled.
5. CBM Labels: Provide fluorescent lamp ballasts which comply with Certified Ballast Manufacturers Association standards and carry the CBM label.

1.5 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period. Warranty Period: 5 years from date of Substantial Completion.
- B. The contractor shall warrant the completed lighting system wiring, equipment, lamps and drivers to be free from inherent mechanical and electrical defects for a period of two (2) years from the date of Substantial Completion. Refer to Division 1 specifications for definition of Substantial Completion.
- C. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion. It will not make any difference when equipment is ordered, delivered or installed, warranties will commence after the Architect issues his letter of "Substantial Completion."

1.6 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver lighting fixtures in factory-fabricated containers or wrappings, which properly protect fixtures from damage.
- B. Store lighting fixtures in original packaging. Store inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, laid flat and blocked off ground.
- C. Handle lighting fixtures carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new.

1.7 SEQUENCING AND SCHEDULING:

- A. Coordinate with other work including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of lighting fixtures with other work.
- B. Sequence lighting installation with other work to minimize possibility of damage and soiling during remainder of construction.

1.8 GENERAL

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- A. Furnish lighting fixtures, lighting equipment components, branch circuiting and lamps for a complete lighting system. All incandescent fixtures shall be prewired type.
- B. The driver and all other parts shall be considered as components of the fixture, and it shall be the responsibility of the manufacturer of the fixture to furnish labor and material required to repair or replace any or all of the components that become defective during the guarantee period stated in this specification.
- C. Location of fixtures on drawings is diagrammatic. Verify locations with site plans, or other reference data for final location and spacing in advance of installation. Examine space conditions and requirements for installation of fixtures. Coordinate installation of fixtures with other trades to avoid interferences.
- D. Wiring channels and socket mountings shall be rigid and accurately made. Sockets shall hold lamps securely against normal vibration and maintenance handling. Socket contacts shall be silver plated. For rapid start lamps on single ballasts, furnish one grounding socket.
- E. Provide approved support for each lighting fixture outlet.
- F. Blemished, damaged, or unsatisfactory fixtures shall be replaced at the direction of the Architect.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or alternatives of the quality necessary to meet the specifications. Manufacturer for each type of fixture are indicated in the fixture schedule.

### 2.2 FIXTURES:

- A. General: Provide lighting fixtures, of sizes, types and ratings indicated. Ship fixtures factory-assembled, with those components required for a complete installation. Design fixtures with concealed hinges and catches, with metal parts grounded as common unit.
- B. Refer to the contract drawings for lighting specifications.
  - 1. **Model numbers are shown for information only. The written description for each fixture shall supersede the model number. It shall be the contractor's responsibility to verify all model numbers. All final fixture finishes shall be selected by the Architect prior to fixture approval. Contractor shall bid on the most expensive finish available for each fixture, unless otherwise noted.**

## PART 3 - EXECUTION

### 3.1 EXAMINATION:

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- A. Examine areas and conditions under which lighting fixtures are to be installed, and substrate for supporting lighting fixtures. Notify Architect in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF EXTERIOR LIGHTING FIXTURES:

- A. Install exterior lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", NEMA standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.
- B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Std 486A and B, and the National Electrical Code.
- C. Fasten electrical lighting fixtures and brackets securely to indicated structural supports, including poles/standards; and ensure that installed fixtures are plum and level.
- D. All pole foundations shall have hot-dipped galvanized steel or stainless steel anchors, washers and nuts for securing the pole to the foundation.
- E. The Electrical Contractor will furnish and install photocells to control the outdoor lighting circuits.

3.3 FIELD QUALITY CONTROL:

- A. Replace defective and burned out lamps for a period of one year following the Date of Substantial Completion.

3.4 ADJUSTING AND CLEANING:

- A. Clean lighting fixtures of dirt and construction debris upon completion of installation. Clean fingerprints and smudges from lenses.
- B. Protect installed fixtures from damage during remainder of construction period.

3.5 GROUNDING:

- A. Provide equipment grounding connections for interior and exterior lighting fixtures as required. Tighten connections to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounds.
- B. Refer also to section Grounding.

END OF SECTION 265619

SECTION 266000 – SOLAR PHOTOVOLTAIC SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, Instructions to Bidders, and Division 1 Specification Sections, apply to this Section.
- B. Requirements of the following Sections apply to this Section:
  - 1. Section 260000 – Summary of Work
  - 2. Section 260500 – Common Work Results for Electrical
  - 3. Section 260526 – Grounding and Bonding for Electrical Systems

1.2 SUMMARY

- A. All work associated with this specification section shall be provided and installed by the Solar (photovoltaic) Panel Vendor (SPV).
- B. This Section includes the fabrication, assembly, installation, initial start-up and acceptance, testing and warranty of roof mounted PV power systems, as described in these specifications and set forth on the contract drawings. This system shall include but not necessarily be limited to solar photovoltaic modules, ballasted roof racking system components, power optimizers, inverters, interconnection wiring, surge suppression units, utility interconnection, data acquisition equipment & wiring and all associated auxiliary equipment required for a complete and fully operational system. Protection of existing roof and work required to maintain existing roof warranties is required and included in all locations. Include final (post work) roof inspections by roof manufacturer at all locations and make repairs indicated by roof manufacturer as necessary to maintain existing warranties.
- C. Project Scope: 63.18+/- kWdc total roof/structure mounted system on multiple roofs, consisting of (108) 585W modules, complete, including (54) power optimizers, inverter with remote monitoring, data logger and revenue grade meter and other components as indicated.
- D. Except as modified herein, materials, equipment, and installation shall be provided in accordance with standards and nationally recognized model codes. Local codes, which deviate from nationally recognized codes or standards in order to satisfy local conditions, are to be followed, unless adherence to them results in less stringent requirements.
- E. The contractor is responsible for providing a complete and operable Photovoltaic system (PV) that meets the requirements of this specification, the electric utility company and any applicable state and/or federal programs for both the interconnection requirements and requirements for grants, rebates, funding, and/or SREC program. The documents shall serve as the basis of design. If any changes to design or equipment are proposed by the Contractor or such changes occur that are the result of other project parameters, the Contractor shall provide signed and sealed drawings of such alternative design. The contractor shall be responsible for all design and construction costs associated with any changes due to alternate designs or equipment provided due to deviation from the basis of design. The signed and sealed drawings and specifications shall be prepared by a professional engineer licensed in the state in which the work is being performed. The drawings shall

be prepared in a format and level of detail as outlined below that allow the contractor to obtain the final construction permit for a complete PV installation. The licensed PE must submit a certificate of professional liability insurance in the amount of \$1 million along with a copy of a valid professional engineering license in the state in which the work is being performed. The signed and sealed drawings shall be issued to the Architect for review and approval prior to ordering any equipment or starting construction. Architect's review of the signed and sealed drawings shall be performed for the limited purpose of checking conformance with the basis of design expressed in the Construction Documents. Such review shall not be conducted for the purpose of determining the accuracy or completeness, or for substantiating instructions for installation or performance of equipment or systems designed by the Contractor or Contractor's representative, all of which remain the responsibility of the Contractor.

- F. Any and all revenues, savings, rebates, tax credits, SREC and other incentives received from incentive and rebate programs shall accrue to the Owner.

### 1.3 DEFINITIONS

A. Module Specification and Evaluation Criteria

Peak Rating Conditions: The peak rating conditions (PRC) for the PV power plant shall be: 1 kW/m<sup>2</sup> total irradiance in the plane of array, air mass 1.5 solar spectrum, and 25°C cell temperature.

B. Nominal Operating Cell Temperature

Nominal operating cell temperature (NOCT) shall be the PV cell temperature obtained when the PV collector is operating under open-circuit steady-state conditions at 800 W/m irradiance in the plane of the array, air mass 1.5 solar spectrum, 20°C ambient temperature, and 1 m/s wind speed.

C. Energy Resource Basis

The solar resource data that shall be utilized for the facility design is the typical meteorological year (TMY) data for Lat, Long: 40.04805, -75.45284 available from the National Oceanic and Atmospheric Administration (NOAA).

D. PV Module Characteristics

The following design specifications (and rating conditions) will be used in evaluating PV Modules proposed for this system.

1. Gross module area (lens area).
2. Nominal operating cell temperature (NOCT).
3. Open-circuit voltage (OCV).
4. Short-circuit current (SCC).
5. Maximum-power voltage and current (MPVC).
6. Module efficiency (ME based upon module area).

7. Average power (AP).

#### 1.4 REFERENCES

- A. The PV system hardware and installed system shall conform to the applicable codes, standards and qualification test criteria listed below.

1. National Electrical Code - ANSI / NFPA 70-2017, especially Articles 690 and 705.
2. Occupational Safety and Health Administration (OSHA) Directives.
3. ANSI/IEEE Standard 928, latest edition, Recommended Criteria for Terrestrial Photovoltaic Power Systems PV system performance criteria.
4. PECO utility interconnection requirements for utility co-generation and interconnection.
5. Photovoltaic Module Qualification:

IEEE 1262, latest edition: Recommended Practice for Qualification of Photovoltaic Modules.

CEI / IEC 1215, latest edition: Design Qualification and Type Approval for Crystalline Silicon.

Terrestrial Photovoltaic Modules.

ANSI / UL 61730, latest edition: All photovoltaic modules shall meet or exceed the requirements of ANSI / UL 61730 Standard for Flat-plate Photovoltaic Modules and Panels.

Factory Mutual Testing Class #3611, latest edition: All photovoltaic modules shall meet or exceed the requirements of Factory Mutual Research for application in NEC Class 1. Division 2, Group D hazardous locations.

5. Power Conditioner Qualification:

IEEE 1547-2018, Rule 21, Rule 14 (HI).

UL 1699B, Photovoltaic (PV) DC Arc-Fault Circuit Protection

UL Subpart 1741, latest edition: All power conditioning equipment must be listed by a recognized laboratory such as Underwriters Laboratories and shall meet or exceed the requirements of UL Subpart 1741 as revised.

ANSI / IEEE 519, latest edition: IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems

FCC Regulations Electromagnetic Interference (EMI) Part 15, Class A.

6. Insulated Cable Engineers Association (ICEA) Standards
7. Local and State Codes and Standards



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#### 1.5 SUBMITTALS

- A. Submittals shall be provided in accordance with Conditions of Contract, Division 1.
- B. Utility applications for Interconnection, including all applicable fees.
- C. Submittals For Approval
  - 1. Product data for the photovoltaic modules including qualification test and product listing criteria.
  - 2. Product data for the inverter, power optimizers, meter, and surge protective device, including qualification testing and product listing criteria.
  - 3. Certified solar shading study with full report for review and approval of the engineer and submission to approving authorities.
  - 4. Shop Drawings showing the complete PV structural support system. The PV manufacturer/integrator shall provide signed and sealed structural shop drawings by a Registered Professional Engineer in PA. Wind loading calculations shall be performed to verify compliance with the IBC 2018 and shall be signed and sealed by a Registered Professional Engineer in PA. Weights of the ballasted roof racking system will be reviewed and approved by the Structural Engineer for the project.
  - 5. Field testing reports.
  - 4. Operation and Maintenance information on the PV system and its major components.
  - 5. Product and system configuration data for the Data Acquisition System.
  - 6. Electrical construction drawings corrected to as-built conditions.
  - 7. Any documentation required by roof manufacturers to ensure continuation of roof warranties.

#### 1.6 SEQUENCING AND SCHEDULING

- A. Coordinate with other work including structural framing systems on the roof, intended to support the PV system.
- B. Coordinate with other electrical Work under Division 26.

#### 1.7 OPERATION AND MAINTENANCE INFORMATION

- A. Operational Data: Provide Inverter manufacturer's operational instructions.
- B. Maintenance Data: Provide PV Modules and Inverter manufacturer's instructions for routine maintenance requirements, and emergency shut-down procedures.

#### 1.8 QUALITY ASSURANCE

- A. PV Module Manufacturer's Qualifications: The PV Module manufacturer shall be a company specializing in the manufacture of PV cells and modules and have at least 10 years of documented experience in this field. The PV Module manufacturer shall be the manufacturer of both the cells and modules provided herein and shall warranty same.
- B. All modules must meet or exceed Underwriter's Laboratory (UL) 1703, International Electrotechnical Commission (IEC) 61646, and Institute of Electrical and Electronics Engineers (IEEE) 1262 test certifications for qualification of photovoltaic modules.
- C. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of International Building Code (IBC) for Zone 4 application. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, IBC: a peak of 2.15g's (3.2 – 11 Hz), and a ZPA of 0.86g's applied at the base of the equipment. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz.
- D. The wind loading for this PV equipment shall be based on 115 mph.
- E. The installer shall be a certified PV installer and shall submit a resume and certification listing information. The installer shall be a NABCEP Certified Installer or shall have passed the examination given by the Florida Solar Energy Center "Installing Grid-Connected Photovoltaic Systems" or by Solar Energy International or by an approved equivalent.
- F. The contractor is responsible for providing all methods of measurement, verification and metering required to; obtain applicable rebates and grants, meet requirements for net metering in accordance with the utility and comply with the requirements for the sale of SREC's.
- G. Follow requirements of roof manufacturers to maintain existing roof warranties.

#### 1.9 REGULATORY REQUIREMENTS

- A. The Inverter and the system's utility interconnection shall satisfy the utility interface requirements of the local Utility including any additional protective relaying and other devices which the Utility may require to supplement the internal safety and control circuitry in the power conditioning unit.
- B. As a part of the system acceptance testing, the Contractor shall be responsible for demonstrating that the PV system meets all interface requirements set forth by the Utility.

#### 1.10 DELIVERY, STORAGE AND HANDLING

- A. General: Transport, handle, store and protect all equipment and materials required under this Section in keeping with provisions of Section "Material and Equipment."
- B. The Contractor shall be responsible for the safe delivery, receipt, storage and handling of the PV modules, Power Conditioning Equipment and other components and materials required for the PV power systems. Title to the equipment shall transfer to the Owner only after the system acceptance tests have been successfully completed and the building has been fully accepted.

#### 1.11 WARRANTY

- A. Photovoltaic Modules: The photovoltaic modules shall have a five-year warranty against defects in workmanship and/or materials. PV modules shall have a minimum twenty five year limited manufacturer's warranty to maintain at least 86 percent of their initial rated output. The PV manufacturer will have the option to either repair or replace any modules found to be defective.
- B. Inverter: The inverter shall have a 20 year performance warranty, extended beyond the standard 12 year warranty. During the 20 year period starting with system acceptance, the manufacturer shall repair or replace the inverter in cases of failure or poor performance if the failure is due to poor materials or workmanship.
- C. The Contractor shall provide the Owner with a full 2-year warranty on the entire PV system and all of its materials, components, equipment and labor. This warranty shall provide for service at the site including the repair and / or replacement of components found to be defective for 2 years from the date of building acceptance by the Owner. The Contractor may include pass-through warranties from the manufacturers of major system components. However, it will be the responsibility of the Contractor to provide initial trouble shooting of the system and to obtain service and guarantee performance by the manufacturers under their warranties.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with the requirements in Section 1.4 above, provide products for the photovoltaic system as follows:
  - 1. Photovoltaic Modules: QCELLS Q.PEAK DUO XL-G11S 585W or approved equal by the Engineer.
  - 2. Inverter:
    - 1. SolarEdge SE40KUS 40kWac inverter for 277/480V three phase interconnection.
  - 3. Power Optimizer: SolarEdge S1201 power optimizer supporting connection of two (2) PV modules in series, maximum 1200W.
  - 4. PV System Racking System: EcoFoot5D by Unirack or approved equal by the Engineer.
    - 1. Low Slope System: Ballasted
    - 2. Clamping range: 30–50mm
    - 3. Dimensions: 16.7"L x 7"W x 6.2"H
    - 4. Typical system weight: 2.4–7.7 psf
    - 5. Module orientation: Landscape
    - 6. Tilt angle: 5° Landscape
    - 7. Module inter-row spacing: 9.9"
    - 8. Roof pitch: 0°–7°
    - 9. Ballast requirements: 4" x 8" x 16"
    - 10. Wind tunnel tested: 150 mph
    - 11. Warranty: 25 years
    - 12. Slip sheets: Required. Coordinate with the General Contractor's roofing contractor. Use 10"x20" under Base; 6"x16" under Mid-Support.

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13. Certified to UL2703 Fire Class A for Type I and II modules
14. Certified to UL2703 Grounding and Bonding
15. SEAOC seismic compliant

5. Revenue Grade Energy Meter: SolarEdge SE-RGMTR-3Y-480V-A with 150:5A CTs or approved equal by the Engineer.
6. Solar Monitoring Software and Equipment: SolarEdge Monitoring Platform online monitoring system or approved equal by the Engineer.

## 2.2 PHOTOVOLTAIC MODULES AND RACKING

- A. Provide QCELLS SOLAR 585W modules or approved equal by the Engineer. The following are the minimum specifications:
  1. The QCELLS Q.PEAK DUO XL-G11S 585W panel line shall be made of bifacial monocrystalline solar cells with a configuration of 12x12 cells.
  2. Connection: #10 USE-2 cabling to MC4 locking connector.
  3. Frame: Anodized aluminum with tempered glass.

## 2.3 POWER OPTIMIZERS

- A. SolarEdge S1201 Power Optimizer to connect two photovoltaic panels in series and increase overall system yield with the following features:
  1. Rated Input DC Power: 1200W.
  2. Maximum Power Point Tracking: 12.5-105Vdc.
  3. Maximum Output Current: 18Adc.
  4. Maximum Output Voltage: 80Vdc.
  5. Rapid Shutdown System: NEC 2017, 2020.
  6. Maximum System Voltage: 1000Vdc.
  7. Output Connector: MC4.
  8. Protection Rating: IP68.
  9. Warranty: 25-year, minimum.

## 2.4 INVERTER

- A. SolarEdge 3-phase inverter for the 277/480V three phase grid with the following ratings and features:

1. AC Nominal Voltage Range (3-Phase): 480V / 422.5V – 529V.
2. AC Frequency Range: 60 Hz / 59.3 Hz – 60.5 Hz
3. Power Factor: +/- 0.85 to 1.0 @ nominal power
4. CEC weighted Efficiency: 98.5%
5. Protection Rating: NEMA 3R
6. Extended Warranty: 20-year, minimum. EC shall purchase extended warranty to extend the standard 12-year warranty to 20 years.
7. Compliance: IEEE-929, IEEE-1547, ANSI C62.92.4, UL 1699B, UL 1741, UL 1998, FCC Part 15 A & B
8. The PV system shall comply, at minimum, with the following standards:
  - a. UL1741, UL1741 SA, UL1741 SB.
  - b. UL1699B.
  - c. IEEE 1547-2018.
  - d. NEC 2017.
9. The inverter shall shutdown or go into a stand-by mode under the following conditions:
  - a. Inverter overtemperature
  - b. Loss of Utility Voltage
  - c. Over frequency, power inverter shuts down when frequency is 61.0 Hz or more for 15 cycles (or as required by utility)
  - d. Utility under frequency, power inverter shuts down when frequency is 58.5 Hz or less for 2 seconds (or as required by utility)
  - e. Utility over voltage and utility under voltage, power inverter shuts down when voltage is outside the tolerances of ANSI C84.1-1982 (approximately 86% to 106%).
  - f. Insufficient Solar Power - When the power available from the PV array is insufficient to supply the tare losses of the inverter, the inverter shall go to a standby mode
  - g. Synchronization Error - when the inverter is unable to synchronize with the utility grid
  - h. The inverter design shall include provision to limit run-on and islanding to no longer than one (1) second, upon the loss of utility voltage.
  - i. The power factor at the AC terminals of the system shall be .85 or higher, lagging, above 20% of rated output.

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- j. The power inverters shall not produce excessive Electromagnetic Interference (EMI) and shall be in compliance with FCC EMI regulations / guidelines, Part 15, Subpart J. FCC regulations.

10. Factory testing of power inverters:

- a. Prior to shipping the power inverters to the site, operability shall be demonstrated. At a minimum, the power inverters shall be tested to demonstrate that all controls and protective functions perform as designed and that the power inverters has the functional capability to be connected to a utility grid.

B. Revenue Grade Energy Meter

- 1. Provide and install SolarEdge SE-RGMTR-3Y-480V-A revenue grade energy meter with 150:5A CTs or approved equal by the Engineer. Meter shall be equipped with RS-485 terminals for connection to the inverter and shall be rated for use on 480V, 3 phase, 4 wire system.

2.5 SOLAR MONITORING AND PROTECTION EQUIPMENT

A. Include the following to integrate with the specified SolarEdge Monitoring Platform online monitoring system:

- 1. Ethernet jack for connection to the internet via the Owner's network.
- 2. Inverter manufacturer shall provide free, online, cloud-based monitoring of the inverter systems.

PART 3 - EXECUTION

3.1 INSTALLATION

A. PV Module Installation:

- 1. Install PV modules on ballasted roof racking system, which shall be installed on the new low-sloped rubber roof structure.
- 2. It is important to emphasize that PV modules produce power directly from sunlight and thus are electrically "alive" as soon as they are removed from their shipping box and exposed to light. Care must be taken when handling and installing PV modules to avoid electrical shock. Live wiring methods should be employed.
- 3. All PV modules shall be cleaned with standard glass-cleaning products to remove dirt deposited during construction prior to initial system start-up and again prior to system acceptance by the Owner.

B. Electrical Connections

- 1. All frames and other metal parts in contact with the PV modules must be solidly grounded.

2. Provide electrical wiring and grounding as per the manufacturer's standards, requirements, shop drawings and the contract drawings.

C. Placards

1. Provide placards, as required & approved by Utility Company and the 2017 NEC Articles 690 & 705, at the main utility transformer/meter location, MDP location and at the PV external AC disconnect. Utility company requires notification of on-site NUG (non-utility generation) and the actual location of the disconnecting means for the NUG (PV on this project).
2. Provide all placards as required in NEC Article 690 and 705.

3.2 SYSTEM ACCEPTANCE TESTING

- A. The test methods and procedures described herein shall be utilized to determine actual post-construction operational, performance and safety characteristics of the PV systems. These tests are based on the IEEE Recommended Practice document (PAR 1373, June 1994 or latest edition) that focuses on utility PV acceptance tests. The test results will be used to compare system performance and operation with the specifications, predicted performance, and applicable codes and standards.
- B. The system acceptance testing will determine that the PV system is functionally operative and meets the design requirements. The tests will also verify that the system, as installed, is safe for personnel as well as equipment, and verify that the system meets the local utility interconnection requirements for paralleling to the grid, and establish or verify system energy performance and power rating.
- C. The tests described in the IEEE specification cover the PV array, array, wiring, power conditioning, protection equipment, and grid interconnection. Throughout this document Owner refers to the owner of the PV system. Contractor refers to the entity providing and installing the PV system or components. Utility refers to the local electric utility to which the PV system is to be connected.
- D. The IEEE specification discusses inspections and tests involving insulation, continuity, grounding, transformer turns ratio, polarity, hi-pot, meggering, instrument calibration, relay settings, I-V curves, functional system operation and operational verification of controls, power protection features and alarms. Performance tests including output voltage and current harmonics, power factor, and overcurrent are also covered. Finally, a system rating procedure is provided.
- E. The local utility may require different levels of system and may require additional tests or have different criteria or procedures than those listed here. The Contractor shall contact the local utility for their specific interconnection requirements and testing.
- F. Contractor shall maintain during construction a current set of all construction drawings/documents marked to reflect any field modifications. These will be used as references for field testing. All drawings / documents affected by field modifications shall be updated to as-built condition and submitted to owner and to the State of NJ prior to offering the system for acceptance.
- G. Five certified copies of the acceptance test report shall be provided to the Engineer for review and shall be included in the O&M Manuals.

- H. The system tests described herein are developed for system acceptance but may also be performed at any time after system acceptance by the building Owner to evaluate system performance for purposes of determining warranty compliance with the original system performance specifications.

### 3.3 TEST SEQUENCE

- A. Testing Prior To Paralleling: Before start-up of the system is attempted, testing as outlined in the following paragraphs shall be completed satisfactorily. The following paragraphs provide general information regarding the procedure of each item of inspection, test or calibration. Exact procedures and evaluation criteria may have to be modified based on local utility requirements and by referring to the manufacturer's instruction, data sheets, specification, drawings, etc.
- B. Inspections: An in-depth inspection shall be conducted to ensure that the system is built and maintained in a workmanlike manner and consistent with industry practice and operational requirements. Torque verification of bolted connections should be performed randomly. Finish or corrosion protection on structures, metal support members and frames should be checked for condition and damage repair. Verify that equipment and system grounding is installed and functional per design.
- C. Wires, Cables and Buses: Electrical cables and wires operated at or below 600V (between the array junction boxes on the dc side and the utility interface point on the ac side) should be tested for continuity and megger tested.
- D. Circuit Breakers: A micro-ohm test should be performed on all the circuit breakers. If this is not possible, a simple continuity check is acceptable.
- E. Inverter/power optimizers: After the inverter, power optimizers and necessary accessory equipment / devices are installed in their final configuration, but prior to paralleling with the grid, perform a visual inspection of wiring, components, enclosure, etc. Verify emergency stop and other controls (as possible). Check for adequacy of grounding.
- J. Initial Start-Up: The test shall demonstrate proper functional operation of control and protective features under normal and abnormal conditions. The majority of these tests are related to the inverter and power optimizers since most of the system operation and control is assumed to be performed here.
1. Inverter Operational Tests
  2. Wake-up and sleep operations
  3. Loss of utility
  4. Loss of dc or array
  5. Remote reset and disable control
  6. Power Quality and System Operation
  7. In addition, over / under voltage and frequency fault conditions must be demonstrated.



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3.4 TRAINING

- A Provide a minimum of 4 hours of onsite training on the PV system and cloud-based software for a minimum of 5 personnel. Provide a minimum of 14 days advance notice prior to the proposed training date.

End of Section 266000

SECTION 270000 – BASIC TELECOMMUNICATIONS REQUIREMENTS

PART 1 – GENERAL

1.1 RELATED WORK:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions Specification Sections, apply to this Section.
- B. Where there are conflicts between the documents listed above comply with the one establishing the more stringent requirements.
- C. All sections of Division 26, 27 and 28 of these specifications also apply to this section.
- D. Provide work specified but not shown on Drawings, and work shown on Drawings but not specified, as though expressly required by both.

1.2 REFERENCES:

- A. All work shall be in compliance with the following codes and agencies. Nothing contained within these specifications shall be misconstrued to permit work not in conformance with the most stringent applicable codes and standards. It is assumed that bidders have to access to, and specific knowledge of, the listed reference materials in order to ensure conformity with them.
  - 1. National Electrical Code (NEC)
  - 2. National Electrical Safety Code (NESC)
  - 3. National Fire Protection Association (NFPA)
  - 4. Federal, State, and Local Codes.
  - 5. National Electronic Manufacturer's Association (NEMA)
  - 6. Institute of Electronic Manufacturer's Association (IEEE)
  - 7. American National Standards Institute/Electronic Industries Association/Telecommunication Industries Association (ANSI/EIA/TIA)
  - 8. Occupational Safety & Health Administration (OSHA)
  - 9. Federal Communications Commissions (FCC)
- B. All new materials, equipment, and installation practices shall meet or exceed the requirements of the following standards, unless specifically instructed otherwise by the owner.
  - 1. Telecommunications Industry Association /Electronic Industries Association ANSI/TIA-568C.0 – Commercial Building Telecommunications Cabling for Customer Premises.
  - 2. Telecommunications Industry Association /Electronic Industries Association ANSI/TIA-568C.1 – Generic Telecommunications Cabling Standard.
  - 3. Telecommunications Industry Association /Electronic Industries Association ANSI/TIA-568C.2 – Balanced Twisted-Pair Telecommunications Cabling and Components Standard
  - 4. Telecommunications Industry Association /Electronic Industries Association ANSI/TIA-568C.3 – Optical Fiber Cabling Components Standard

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5. Telecommunications Industry Association /Electronic Industries Association (TIA/EIA) 568-B – Commercial Building Telecommunications Wiring Standard
6. TIA/EIA 569-B – Commercial Building Standard for Telecommunications Pathways and Spaces.
7. ANSI/TIA/EIA 606-B – Administration Standard for Telecommunications Infrastructure of Commercial Buildings.
8. ANSI/TIA/EIA 607-B –Commercial Building Grounding and Bonding Planning and Installation Methods for Commercial Buildings.
9. ANSI/TIA/EIA 758-B – Customer-Owned Outside Plant Telecommunications Infrastructure Standard.
10. TIA/EIA TSB-67 – Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems.
11. TIA/EIA TSB-72 – Centralized Optical Fiber Cabling Guidelines.
12. Underwriters Laboratories (UL) Cable Certification and Follow-up Program.
13. National Electrical Manufacturers Association (NEMA).
14. American Society for Testing Materials (ASTM).
15. National Electric Code (NEC) 2014 Current Edition.
16. NEMA 250
17. Institute of Electrical and Electronic Engineers (IEEE).
18. UL Testing Bulletin.
19. American National Standards Institute (ANSI) X3T9.5 Requirements for UTP at 100 Mbps
20. BICSI Telecommunications Distribution Methods Manual (TDMM) – 13th Edition, Current Edition.
21. BICSI Customer-Owned Outside Plant Design Reference Manual (OSP) – 5th Edition.
22. UL Testing Bulletin.
23. UL 1863 Underwriters Laboratories Standard for Safety – Communications Circuit Accessories
24. UL 467-2004 Grounding and Bonding Equipment
25. UL 50 Electrical Cabinets and Boxes
26. UL 1076 Security Systems
27. OSHA CFR Standards-29, Section 1910 or most current edition.
28. OSHA 1910.268 Telecommunications

C. References to standards of organizations are made herein in accordance with the following abbreviations:

29. ADA Americans with Disabilities Act
30. ADAAG Americans with Disabilities Act Accessibility Guideline
31. ANSI American National Standards Institute Inc.
32. ASA American Standards Association
33. ASTM American Society for Testing and Materials

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| 34. | BICSI | Building Industry Consulting Service International, Inc.;              |
|     | and   | Telecommunications Distribution Methods Manual (TDMM), Latest Edition, |
|     |       | Telecommunication Cabling Installation Manual, Latest Edition.         |
| 35. | BOCA  | Building Officials and Code Administrators International, Inc.         |
| 36. | CBEMA | Computer and Business Equipment Manufacturers Association              |
| 37. | EIA   | Electronic Industries Association                                      |
| 38. | FAA   | Federal Aviation Agency  |
| 39. | FCC   | Federal Communications Commission                                      |
| 40. | ICEA  | Insulated Cable Engineers Association                                  |
| 41. | IEC   | International Electro-technical Commission                             |
| 42. | IEEE  | Institute of Electrical and Electronics Engineers                      |
| 43. | ISO   | International Standard Organization                                    |
| 44. | NEC   | National Electrical Code (NFPA 70)                                     |
| 45. | NEMA  | National Electrical Manufacturer's Association                         |
| 46. | NESC  | National Electrical Safety Code  |
| 47. | NFPA  | National Fire Protection Association                                   |
| 48. | NTSC  | National Television Standards Committee                                |
| 49. | OSHA  | Occupational Safety and Health Administration                          |
| 50. | TIA   | Telecommunications Industry Association                                |
| 51. | UL    | Underwriters Laboratories, Inc.  |

- D. Work installed shall be in strict compliance with governing codes and regulations. Installation shall be in accordance with installation recommendations and details provided by product manufacturers unless exceeded in quality by these specifications. Work called for in the specifications or shown on the drawings that is deemed contrary to the code by the local authority having jurisdiction governing shall be brought to attention of Engineer prior to rough-in for clarification or revision.

### 1.3 DEFINITIONS AND ABBREVIATIONS:

- A. Structured Cabling System (SCS): The SCS includes all components, installation, and testing required for a complete and warranted system to achieve a specified level of performance.
- B. Work Area (WA): The WA is the location that terminates the telecommunications outlet (data/voice) on the end of the horizontal cable system and then provides modular connectivity to occupant devices.
- C. Equipment Room (ER)/Telecommunication Room (TR): The ER/TR provides space for the horizontal distribution equipment. It provides the link from the Backbone Distribution System to the Horizontal Distribution System. The Equipment/Telecommunication Room contains terminations, interconnections and cross-connections for telecommunications distribution cable.
- D. Horizontal Distribution System: The Horizontal Distribution System connects the Work Area to the ER/TR. The Horizontal Distribution System consists of the horizontal pathway and the horizontal cabling system. The horizontal pathways are used to distribute, support, and provide access to the

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horizontal cabling system. The horizontal cabling system is the medium used for transporting telecommunications signals and consists of both cable and connecting hardware.

E. Abbreviations:

1. AFF – Above finish floor
2. BET – Building Entrance Terminal
3. EMI – Electromagnetic Interference
4. IC – Intermediate Cross-connect
5. IDC – Insulation displacement connector
6. IDF – Intermediated Distribution Frame
7. MC – Main Cross-connect
8. MDF – Main Distribution Frame
9. PP – Patch Panel
10. PVC – Polyvinyl Chloride
11. RR – Relay Rack
12. UTP – Unshielded Twisted Pair

1.4 GENERAL REQUIREMENTS:

A. First-named Manufacturer:

1. First-named manufacturer's device, equipment or system has been used in specifications and drawings to meet the job requirements and to determine the space and dimensional requirements. Verify that devices, equipment, systems or products by other than the first-named manufacturer used as basis for proposal will meet the job requirements and will fit the allocated space.
2. Listing of a manufacturer as acceptable does not in any way relieve the Contractor from the Responsibility for providing a device, equipment or system that meets the requirements of the specifications.
3. No extra cost will be allowed, due to effect on other trades when bid is based on products other than first-named manufacturer. Contractor shall be responsible for coordination required for the use of substituted devices, equipment systems, or products by other than the first named manufacturer.

B. Drawing Details: Since the installation of devices, equipment and systems may vary by each manufacturer and the "approved manufacturer" for the job may be unknown at the time the drawing details were made, the details shown on the drawings to be accepted by the Contractor as general in nature and are not used for the installation. Contractor shall obtain from the "approved manufacturer" of the devices, equipment or systems detailed installation drawings for their proper installation.

C. Deviations from Specified Devices, Equipment or System: While it is recognized that devices, equipment or systems by other than the first-named manufacturer may not be identical, the Contractor shall verify and provide devices, equipment, systems, or products that meet the specified job requirements. All deviations of devices, equipment, systems, or products from the first-named manufacturer shall be clearly noted on shop drawing submittal or by cover letter. Engineer reserves the right to reject all devices, equipment or systems he feels does not meet the specified job requirements.

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- D. Submission of shop drawings will be considered as indicating that space requirements have been reviewed and that submitted equipment will fit space allocated with due concern given to access required for maintenance purposes and heat dissipation.
- E. Contract drawings and specifications are complementary and what is called for by one shall be binding as if called for by both.
- F. Contractor shall furnish and install all labor and material required to complete installation including accessories, fittings, auxiliaries, and components required for proper performance of systems.
- G. The word “provide” as used on the plans and in these specifications shall be understood to mean all administration, labor, tools, materials and equipment required for a complete and operable installation of the referenced item, system and/or product, including testing.
- H. Location of Equipment and Devices:
  - 1. Location of the telecommunication equipment and devices shown are approximate. Determine the exact location of the equipment and devices by checking the Architectural drawings, field measurements, or the approved shop drawings.
  - 2. Relocate equipment or devices when directed by Engineer without cost, providing equipment has not been installed and the new location is not greater than 10 feet from the location shown.
- I. Quality Control:
  - 1. Exposed Work in Finished Spaces: Install telecommunication devices and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed.
  - 2. Equipment Access: Install telecommunication devices and equipment to facilitate servicing, maintenance and repair or replacement. As much as practical, connect equipment for ease of disconnecting with minimum of interference with other installations.
  - 3. Cleanliness: Contractor shall keep debris and dirt from around, on top of and the inside of all telecommunication equipment he provides during construction.

1.5 QUALITY ASSURANCE:

- A. Comply with NFPA 70. Comply with applicable local code requirements of the Authority having jurisdiction.
- 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.

1.6 LIST OF MANUFACTURERS FOR MATERIAL AND EQUIPMENT:

- A. Contractor shall submit List of Material and Equipment within 2 calendar weeks after award of contract by Owner.
- B. Approval of the shop drawings will be subject to the submission of material and equipment by the manufacturers shown on this list.

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- C. Provide the first-named manufacturer for material and equipment on project if the List of Material and Equipment is not received by the Engineer within the prescribed time limit, or if the specified equipment or material is not listed on the submitted list. Reference Article 1.3 above for first-named manufacturer requirements.

1.7 MATERIALS AND WORKMANSHIP:

- A. Material and equipment required under this contract shall be new unless otherwise specified. Workmanship shall be first class and be performed by persons qualified in respective trades.
- B. Material shall meet requirements of governing codes and regulations.
- C. UL Listing: Telecommunication material, equipment and systems, where applicable, shall be UL listed.

1.8 CONTRACTOR QUALIFICATIONS

- A. All contractors must meet these requirements to be considered qualified for installation:
  - 1. The cable and hardware manufacturers of the cabling and hardware to be installed must certify contractor. The contractor must present proof of this certification in advance of bidding the contract.
  - 2. Contractor will assign an on staff RCDD to the project. Copy of registration must be submitted at time of shop drawings. The RCDD will visit the job site at least twice a week to review work and schedules.
  - 3. The contractor must be bonded and possess a valid state Contractor's License, issued at least 5 years prior to the date of this bid.
  - 4. The selected low voltage installer shall provide a 25-year manufacturer warranty for the cabling. This warranty shall include defects in materials and workmanship. The warranty period shall begin at the date of Engineer acceptance of the work. Quality and workmanship shall be evaluated by Owner and designated representatives only.
  - 5. Contractor must be certified to install the cabling and termination materials they provide. A certificate verifying this certification must be submitted with the bid documents. Every technician who terminates a connection must be certified in that connectivity. A copy of certification for each technician must be submitted to Engineer prior to starting the project.

1.9 COORDINATION:

- A. Work Coordination: Coordinate work of this section with the security, and local area network (LAN) contractors and suppliers:
  - 1. Meet jointly with representatives of the above organizations and Owner's representatives to exchange information and agree on details of equipment arrangements and installation interfaces.
  - 2. Record agreements reached in meetings and distribute record to other participants.
  - 3. Adjust the arrangements and locations of distribution frames, patch panels and cross-connect in telecommunication rooms to accommodate and optimize the arrangement and space requirements of the voice, data and video equipment.

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- B. Coordinate work with other contractors and/or building elements to eliminate interferences. Interferences due to lack of coordination shall be corrected to provide proper clearance and access without additional compensation. Telecommunication equipment shall not be hung from piping or ductwork or from hangers supporting piping or ductwork. Install cable tray, conduit and boxes giving right-of-way where space is available to systems such as plumbing, drain and fire protection lines required to be installed at a specified slope.
- C. Adequate clearance shall be maintained to allow access, repairs and removal of equipment and devices. Protect installation of equipment or devices from being obstructed by other Contractors.
- D. Permanent openings or knockout panels shall be provided to permit future service or replacement of system components, but not necessarily for entry or exit of entire assembled units.
- E. Contractor shall provide arrangements for hoisting equipment and assume related cost. Routes used by hoisting vehicles and vehicle parking shall be approved by Engineer prior to their use.
- F. Building structure is designed for supporting equipment at its permanent location. Provide necessary shoring or other protection necessary for moving heavy equipment to permanent location.
- G. Contractor shall coordinate his equipment delivery with construction progress in order that installation may be made in an orderly and safe manner.

1.10 SITE OBSERVATION:

- A. Visit site prior to preparation of bid and determine conditions that affect execution of work. This includes but is not limited to exact locations of existing equipment, type supports, wire and conduit lengths, ceiling access and sleeves through existing smoke and fire partitions.
- B. Locations and elevation of existing underground facilities such as manholes and poles, sewers, water piping, duct banks, cables, and conduits are as exact as can be determined from available information and their accuracy cannot be guaranteed. Exact location and elevation of these services shall be verified by Contractor prior to excavation or installation of work. Exercise special care when excavating at or near the general location of underground utilities to avoid damage to utility services, as well as to assure safety. Existing services damaged due to operation of Contractor shall be repaired to satisfaction of Owner and Utility Company at Contractor's expense.
- C. Connections to or relocation of existing utility lines requiring temporary discontinuation of services which are in active use shall be scheduled and coordinated with Utility companies and representatives of Owner. Premium time required for installation of connections and relocations shall be included in bid. Services shall not be left disconnected at end of working day or weekend unless authorized by representatives of Utilities and Owner.
- D. Failure to be acquainted with job site construction conditions under which work is to be performed will not be justified for additional compensation

1.11 MOUNTING AND LOCATIONS:

- A. Location of Equipment and Devices:



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1. Locations of telecommunication equipment and devices shown are approximate. Determine exact location by checking field conditions and approved shop drawings.
  2. Relocate equipment or devices provided under this contract when directed by Engineer without cost, provided equipment has not been installed and new location is not greater than 10 feet from location shown.
  3. Data outlets or other system outlets within room shall be located at same height, and of same vertical configuration.
  4. Wiring, signal and control devices, where provided, shall be flush-mounted in finished areas.
- B. Mounting Heights: Mounting heights shall be to center of device's outlet box unless otherwise indicated by existing conditions or Engineer details. Mounting height of devices and equipment shall comply with following schedule, unless specifically called out on the drawings:
1. Telecommunication Devices:
    - a. Telephone Outlets (Desk Phones) 1'-6" above floor
    - b. Telephone Outlets (Wall Phones) 3'-6" above floor – Phone top button max 48"
    - c. Data Outlet 1'-6" above floor
    - d. TV, Video or CCTV Outlets (floor units) 1'-6" above floor
    - e. TV, Video or CCTV Outlets (wall units) 6'-0" above floor
    - f. Signal Bells, Buzzers, etc. 1'-0" below ceiling

1.12 FINAL OBSERVATION:

- A. Reference Division 01 Closeout Procedures for additional information in regard to final observation.
- B. Contractor shall review requirements of Contract Documents, observe work and inform parties involved of work to be corrected or completed before project can be deemed substantially complete.
- C. Notify Engineer in writing, when project is substantially complete listing those items of work remaining incomplete and anticipated date that remaining work will be completed. Final observation of project will then be scheduled by Engineer.
- D. Engineer reserves right to cancel and re-schedule observation in event considerably more work remains to be completed or corrected than indicated in written request for observation.
- E. Representative of Contractor shall be present at Engineer's and Owner's final observation.
- F. Items not completed or found not complying with drawings or specifications by Engineer will be identified in observation report by Engineer.
- G. Copy of final observation report will be given to Contractor. Deficient items on observation report shall be corrected within a mutually agreed upon time, not exceeding two (2) weeks. Contractor shall initial and date items on report after corrections have been completed.
- H. Engineer will make final check after items have been corrected. Contractor shall be present during final check and shall verify that corrections have been made.

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1.13 TESTING:

A. General:

1. Contractor shall be responsible for providing tests, and record of test to Engineer and Authority Having Jurisdiction. Testing shall be performed by and under direct supervision of Contractor and shall be made only by qualified personnel fully experienced in this type of testing.
2. Contractor shall provide necessary test equipment. Checking of factory wiring and other preliminary work is preparing for telecommunication tests shall be responsibility of Contractor.
3. Tests shall be scheduled with Engineer and manufacturer's representative. Testing shall be during normal working hours unless otherwise indicated or specified.
4. Contractor shall correct faults, malfunctions or failures discovered during tests. Faulty equipment or devices shall be replaced with new equipment or devices provided by Contractor. Replaced equipment or devices shall be retested after replacement to verify their correct operation. When the equipment or device is part of a system, the system shall be retested to verify its correct operation.

B. Tests:

1. Tests are defined under the various Division 27 specification sections.

1.14 WARRANTY:

- A. Network cabling (SMFO, Cat 6 and connectivity devices) provide extended manufacturer's warranty, for a minimum of 25 years from the date of occupancy, shall include providing replacement or repair of defective product(s) and labor for the replacement or repair of such defective product(s) for the period indicated above.

PART 2 – PRODUCTS

- 2.1 Not applicable.

PART 3 – EXECUTION

- 3.1 Not applicable.

END OF SECTION 270000

## SECTION 27 05 00 – COMMON WORK RESULTS FOR COMMUNICATIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes
  - 1. General requirements
  - 2. Qualifications
- B. Related Requirements
  - 1. Section 27 11 26 Communications Rack Mounted Power Protection and Power Strips
  - 2. Section 27 21 29 Data Communications Switches
  - 3. Section 27 21 33 Data Communications Wireless Access Points
  - 4. Section 27 26 23 Network Programming and Integration Requirements
- C. Narrative: The intent of this section is to document the requirements that apply to all sections of this division.

#### 1.2 REFERENCES

- A. Abbreviations and Acronyms
  - 1. NOC: Network Operations Center
  - 2. TESD: Tredyffrin/Easttown School District
- B. Definitions
  - 1. Provide: Furnish and install, inclusive of all administration, labor, tools, materials, and equipment required for a complete and operable installation of the referenced item, system, and/or product.

#### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate work with other contractors and site personnel to eliminate interference. Interferences due to insufficient coordination shall be corrected to provide proper clearance and access without additional compensation.
- B. Coordinate delivery of material and equipment and removal of waste with site manager.

#### 1.4 GENERAL REQUIREMENTS

- A. The Owner's General Terms and Conditions, Special Conditions, General Provisions and General Requirements Sections ("Owner's Documents" collectively) apply to this Section and shall be considered as forming an integral part of this Specification and shall be reviewed thoroughly

before proposals for any Work are submitted. Unless this Section contains statements that are more definitive or more restrictive than those contained in Owner's Documents, this Specification shall not be interpreted as waiving or overruling any requirements expressed in the Owner's Documents.

- B. In the event of a conflict between any of the Owner's Documents, the Contractor shall comply with the one establishing the more stringent requirements.
- C. In the event of a conflict between drawings and specifications, the Contractor shall obtain clarification from the Engineer in writing before proceeding.
- D. The Contractor shall furnish equipment and materials, and perform work, when it is shown on the drawings or called for by the specifications as though expressly required by both.
- E. The Contractor shall, at no additional cost to the Owner, be responsible for obtaining, when necessary, timely access to each standard and specification incorporated by reference into the specifications, and for maintaining sufficient knowledge of them to ensure conformance.
- F. All work results shall comply with the laws, ordinances, codes, certifications, and regulations of the following jurisdictions, agencies, and organizations that are in effect at the time the work is performed.
  - 1. Federal, state, and local codes.
  - 2. Federal Aviation Administration (FAA)
  - 3. Federal Communications Commission (FCC)
  - 4. Occupational Safety & Health Administration (OSHA)
- G. Exposed Work in Finished Spaces: Install telecommunication devices and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed.
- H. Equipment Access: Install telecommunication devices and equipment to facilitate servicing, maintenance, and repair or replacement. To the extent practical, connect equipment to enable disconnection without disrupting other installations.
- I. Maintain adequate clearance to permit access, repair, and removal of equipment whenever practical.
- J. Cleanliness: Keep debris and dirt from around, on top of, and inside all telecommunication equipment prior to and during installation.
- K. Arrange for hoisting and lifting equipment necessary for installation and assume the related costs. Routes used by hoisting or lifting equipment and vehicle parking shall be approved by the site manager.
- L. Building structures are designed for supporting equipment at its permanent installed location. Provide necessary shoring or other protection for moving heavy equipment to permanent installed location.

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- M. Failure to be well-acquainted with job site and construction conditions under which work is to be performed shall be insufficient justification for changes to cost, schedule, or technical requirements.

#### 1.5 CLOSEOUT SUBMITTALS

- A. As-built report with drawings as necessary to fully document all work results under this division.
  - 1. Outline due at substantial completion.
  - 2. Draft due at final completion.
  - 3. Final due within two weeks of final completion.

#### 1.6 QUALITY ASSURANCE

- A. Install all equipment and materials in a neat and workmanlike manner.
- B. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative.
- C. Provide equipment and materials of the quality and manufacture indicated. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- D. Provide new materials and equipment required under this contract unless otherwise specified.
- E. Workmanship shall be first class and performed by persons qualified in respective trades.
- F. Provide material that meets requirements of governing codes and regulations.
- G. UL Listing: Telecommunications material, equipment, and systems, where applicable, shall be UL listed.
- H. Qualifications:
  - 1. Work crew:
    - a. At least one member of crew holds a current manufacturer certification covering the specific products and methods of installation, integration, and/or test required for the applicable section; holds an approved equivalent certification/credential; or provides evidence of greater than five (5) years’ experience with the same.
    - b. Each member of crew provides evidence of greater than three (3) years’ experience performing work related to the applicable section or is performing work under the requirements of an approved apprenticeship program and close supervision of a qualified crew chief.
  - 2. The Contractor shall be bonded and possess a license valid in the state in which the work is to be performed at the time of bid submission and at the time the work is performed.
- I. The Contractor shall provide a warranty covering defects in workmanship meeting each of the following requirements.
  - 1. Duration: 10-years

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2. Commencement: As of the date of Engineer acceptance of the work.
3. Coverage: All material, equipment, and labor necessary to correct the defect(s), re-program, and re-test the affect system components.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Storage and Handling: Avoid breakage, denting, and scoring. Replace damaged products prior to installation at no additional cost to Owner. Store equipment and materials in original packaging in a clean, dry space; protect from weather and construction traffic.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 270500 – TELECOMMUNICATIONS INFRASTRUCTURE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions Specification Sections, apply to this Section.
- B. Where there are conflicts between the documents listed above comply with the one establishing the more stringent requirements.
- C. All sections of Division 26, 27 and 28 of these specifications also apply to this section.
- D. Provide work specified but not shown on Drawings, and work shown on Drawings but not specified, as though expressly required by both.

1.2 SUMMARY

- A. Section includes raceways, fittings, boxes, enclosures, and cabinets for telecommunication wiring.
- B. Related Sections include the following:
  - 1. Division 27 Telecommunications Specifications

1.3 REFERENCES

- A. Conflicts:
  - 1. Between referenced requirements: Comply with the one establishing the more stringent requirements.
  - 2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements.

1.4 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. EMT: Electrical metallic tubing
- C. GRC: Galvanized rigid steel conduit.
- D. HDPE: High-density polyethylene
- E. PVC: Polyvinyl chloride
- F. RNC: Rigid Nonmetallic Conduit

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1.5 SUBMITTALS

- A. Submit product cut sheets with highlights for the specific project options/requirements for the engineer's review and approval.

1.6 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. Verify conduit runs do not interfere with existing or new systems within each facility.

PART 2 - PRODUCTS

2.1 METAL AND NONMETALLIC CONDUITS AND FITTINGS

- A. Refer to Division 26.

2.2 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

- A. Description: Comply with UL 2024; flexible-type pathway, approved for plenum, riser or general-use as identified on the drawings (Not applicable for armored cables).
  - 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.
  - 3. Equal to 1-1/4" plenum rated, orange, corrugated Innerduct.

2.3 CABLE HANGERS (*J-Hooks*)

- A. Provide cable hangers a maximum of 3' on center wherever cable tray or conduit is not present and only above drop ceilings.
- B. Ceiling ties and rods shall not be used to hang cable or cable supports without the approval of GMIA.
- C. Load hangers as recommended by the manufacturer. Provide hangers side by side on a common bracket where cable quantities require.
- D. Do not install cables loose above lock-in type, drywall or plaster ceilings.
- E. Cables shall be installed at least 3 in. above the ceiling tiles and shall not touch the ceiling.
- F. Do not support cable from ceiling system tie wires or grid in fire rated systems.
- G. Cable hangers (j-hooks) shall be rated to support Category 6 data cable.



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2.4 BOXES, AND ENCLOSURES

- A. Refer to Division 26.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
  - 1. Exposed Above Grade Conduit: GRC.
  - 2. Covered Walkways: GRC.
- 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: Rigid steel conduit. Pathway locations include the following:
    - a. Fire Rated Walls: GRC sleeve with 3M fire stop.
    - b. Outdoor walkways and vestibules.
  - 4. High, open ceilings (*ie. Gyms*): EMT
  - 5. Concealed in non-accessible Ceilings and Interior Walls and Partitions: EMT.
  - 6. Concealed in accessible ceilings: Loose cable on J-Hooks.
  - 7. Damp or Wet Locations: GRC.
  - 8. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway.
- C. Minimum Pathway Size: 3/4-inch trade size.
- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
  - 1. Fittings for Metal Conduits: Steel, compression type. Die-cast fittings will not be allowed.
  - 2. Expansion Fittings: provide expansion fittings at all expansion joints located within 6" of a building expansion joint.
- E. Install surface pathways only where indicated on Drawings.
- F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

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.

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- B. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- C. Complete pathway installation before starting conductor installation.
- D. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- E. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- G. Support conduit within 12 inches of enclosures to which attached.
- H. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for pathways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- I. 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.
- J. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- K. 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.
- L. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- M. 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.
- N. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- O. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.
- P. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
  - 1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
  - 2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
  - 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.

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- Q. 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.
- R. 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.
  - 2. Where an underground service pathway enters a building or structure.
  - 3. Where otherwise required by NFPA 70.
- S. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- T. Expansion-Joint Fittings:
  - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
  - 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 temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F 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 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 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.
- U. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- V. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
- W. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- X. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- Y. Set metal floor boxes level and flush with finished floor surface.

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- Z. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### 3.3 LABELING

- A. The contractor shall develop and submit for approval a labeling system for the cable installation. The Owner will negotiate an appropriate labeling scheme with the successful contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.
- B. All labeling must comply with ANSI/TIA-606-B and GMIA Technical Specifications.
- C. All conduit or cabling in cable tray must be labeled (with ¾" minimum width vinyl labels manufactured for this use) at a minimum 30-foot interval (or within sight from any location, whichever distance is less) with
  - 1. the name of the owner of the cable,
  - 2. the purpose of the cable,
  - 3. the date of installation,
  - 4. cable type
  - 5. the identification of room numbers where each end of the cable run is located, the relay rack or data cabinet, patch panel, slots or ports.

### 3.4 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07 and 26.

### 3.5 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 270500

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SECTION 271000 – TELECOMMUNICATIONS CABLING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions Specification Sections, apply to this Section.
- B. Where there are conflicts between the documents listed above comply with the one establishing the more stringent requirements.
- C. All sections of Division 26, 27 and 28 of these specifications also apply to this section.
- D. Provide work specified but not shown on Drawings, and work shown on Drawings but not specified, as though expressly required by both.
- E. Related Sections:
  - 1. Division 26 Specifications
  - 2. Division 27 Specifications

1.2 SUMMARY

- A. This section includes the requirements for furnishing and installing optical fiber backbone of the communications infrastructure as specified and shown on the contract drawings.
- B. This section includes the requirements for furnishing and installing UTP CAT 6 and 6A copper data cabling and IDF / MDF patch cables.
- C. This section includes:
  - 1. Optical Fiber Optical Backbone Cabling, Terminations and Fiber Shelves.
  - 2. UTP CAT 6A PoE IP CCTV, Data and Telephone Cabling and Patching.
  - 3. UTP CAT 6A for WAP Cabling and Patching.
  - 4. CAT 6 Patch panels.
  - 5. Racks, UTP wire-management and surge equipment.

1.3 REFERENCES

- A. The publications list below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

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C. Conflicts:

1. Between referenced requirements: Comply with the one establishing the more stringent requirements.
2. Between referenced requirements and contract documents: Comply with the one establishing the more stringent requirements.

D. References:

1. ANSI/TIA/EIA-568-B – Commercial Building Telecommunications Cabling Standard.
2. ANSI/TIA/EIA 568-B.1 - Commercial Building Telecommunications Wiring Standards, General requirements.
3. ANSI/TIA/EIA 568-B.2 - Commercial Building Telecommunications Wiring Standards, Balanced Twisted Pair Cabling Components.
4. ANSI/TIA/ EIA-568-B.2-1 – Additional Transmission Performance Guidelines for 4-Pair 100 Category 6 Cabling.
5. ANSI/TIA/EIA 568-B.3 - Commercial Building Telecommunications Wiring Standards, Optical Fiber Cabling Components standards.
6. ANSI/TIA/EIA 568-B.3 .1 – Additional Transmission Performance Specifications for 50/125µm Optical fiber Cables.
7. ANSI/TIA/EIA 569 - Commercial Building Standard for Telecommunications Pathways and Spaces.
8. ANSI/TIA/EIA 606-A – Administration Standards for Telecommunications Infrastructures.
9. ANSI/TIA/EIA Joint Standard – 607-A – Commercial Building Grounding and Bonding requirements for Telecommunications.
10. ANSI/TIA/EIA 526-7 – Measurement of Optical power Loss of Installed Single-mode Fiber Cable Plant (Method A).
11. ANSI/TIA/EIA 758 – Customer Owned Outside Plant Telecommunications Cabling Standard.
12. ANSI/TIA/EIA 758-1 - Customer Owned Outside Plant Telecommunications Cabling Standard.
13. Building Industry consulting services International (BICSI) Distribution Methods Manual (TDMM).
14. Building Industry consulting services International (BICSI) Customer Owned Outside Design Manual.
15. Institute of Electrical and Electronic Engineers (IEEE).
16. National Electrical Manufacturers Association (NEMA).
17. National Fire Protection association (NFPA) 72, National Electrical Code (NEC).
18. TIA/EIA-TSB-67 – Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems.
19. TIA/EIA-72 – Centralized Optical Fiber Cabling Guidelines, October 1995.
20. TIA/EIA PN-3398 (Cabling practices for Open Offices).
21. Underwriters Laboratories (UL) Cable Certification and Follow-up Program.

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- 22. American Society for Testing Materials (ASTM).
- 23. American National Standards Institute (ANSI) X3T9.5 Requirements for UTP at 100 Mbps.

#### 1.4 DEFINITIONS

- A. ANSI – American National Standards Institute
- B. ASTM – American Society for Testing Materials
- C. AWG – American Wire Gauge
- D. BICSI – Building Industry Consulting Services International
- E. EIA –Electronics Industries Association
- F. ELFEXT – Equal Level Far End Crosstalk
- G. FEXT – Far End Crosstalk
- H. Gbps – Gigabits Per Second
- I. IEEE – Institute of Electrical and Electronic Engineers
- J. ISO – International Organization for Standardization
- K. LAN: Local Area Network.
- L. Mbps – Megabits Per Second
- M. NEC – National Electrical Code
- N. NEMA – National Electrical Manufacturing Association
- O. NEXT – Near End Crosstalk
- P. OIT: Office of Innovation and Technology
- Q. PSELFEXT – Power Sum Equal Level Far End Crosstalk
- R. PVC – Polyvinyl Chloride
- S. RCDD – Registered Communications Distribution Designer
- T. TIA – Telecommunications Industry Association
- U. UL – Underwriter’s Laboratories
- V. UPS: Uninterruptible Power Supply

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1.5 SUBMITTALS

- A. General: Submit all documentation in accordance with specifications.
- B. Shop Drawings: Submit all shop drawings in accordance with TESD requirements.
- C. Product Data: Submit all product data in accordance with TESD requirements.
- D. Manufacturer's data for all proposed equipment and materials.
- E. Provide shop drawings indicating the intended cable layout and pulling plan prior to beginning cable pulling.
  - 1. Contractor shall provide general procedures for the installation process.
  - 2. Contractor shall identify pulling point locations.
  - 3. Contractor shall identify pulling tensions and bend radii.
- F. Provide calculations and recorded values for actual cable run pulling tensions and recordings of their actual values.
- G. Provide cable inventory data for all fiber optic and Cat 6 cabling and termination equipment. Submit data electronically in a TESD IT approved format. Data to be provided includes:
  - 1. Manufacturer's Name.
  - 2. Manufacturer's Part Numbers and Comm Code Numbers.
- H. Cable Numbers utilizing the TESD IT cable numbering standard.
- I. Submit As-builts (Record Drawings): Furnish As-built CAD drawings of completed work including cable numbers. A full size hard copy and electronic copy on flash drives shall be furnished to TESD IT.

1.6 CONTRACTOR'S DUTIES

- A. The Contractor shall install fiber optic backbone cabling in order to provide a fully operational, tested, certified and warranted cabling system.
- B. The Contractor shall provide all cable testing to meet or exceed industry standards for CAT 6 and 6A UTP cables.
- C. The Contractor shall comply with all codes, ordinances, regulations, and other legal requirements of public authorities, which bear on performance of Work.
- D. The Contractor shall have the chosen manufacturer provide written guidelines for what constitutes warranty liability issues regarding moves, adds, and changes to the cable plant performed by TESD IT.

1.7 QUALITY ASSURANCE

- A. The Contractor shall be certified by the manufacturer of the products, adhere to the engineering installation, testing procedures, and utilize the authorized manufacturer components to be installed.



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- B. All members of the installation team shall be certified by the manufacturer as having completed the necessary training to complete their part of the installation. Resumes of the entire team shall be provided along with documentation of completed training courses. Submit resume and copy of technician's license.
- C. Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of telecommunications cabling products and shall be the manufacturer's latest standard design in satisfactory use for at least one (1) year prior to bid opening.
  - 1. Items of the same classification shall be identical. This requirement includes cable, equipment, modules, assemblies, parts, and components.
- D. All equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the Specification shall be subject to the control and approval of the TESD IT Representative. Equipment and materials shall be of the quality and manufacturer indicated. The equipment specified is based on the acceptable manufacturers listed. Where "or equal" is stated, equipment shall be equivalent in every way to that of the equipment specified, and subject to approval.

#### 1.8 DELIVERY AND STORAGE

- A. The Contractor shall store products in accordance with manufacturer's instructions. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer's instructions. Storage containers shall include adequate security mechanisms to safeguard all equipment.

#### 1.9 PROJECT CONDITIONS

- A. Environmental Limitations: System components shall be equipped and rated for the environments where installed.
  - 1. Interior, Controlled Environment: System components shall be rated for continuous operation in ambient conditions of 2 to 40 deg C dry bulb and 20 to 90 percent relative humidity, noncondensing.
  - 2. Interior, Uncontrolled Environment: System components installed in non-air-conditioned interior environments shall be rated for continuous operation in ambient conditions of 0 to 122 deg F (minus 18 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.
- B. Verify that field measurements are as shown on Drawings; no media, fiber or copper, shall be installed in lengths surpassing Standards based length requirements.

#### 1.10 WARRANTY

- A. The warranty on all materials, services, and adherence of the cabling system to this specification shall be for a period of not less than twenty-five (25) years.
  - 1. If items supplied as part of this project have longer warranties, the Contractor shall supply longer warranty.

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- B. The warranty shall certify that the cabling system shall support and conform to ANSI/TIA/EIA-568B specifications covering any current or future application, which supports transmission over a properly constructed cabling system.
- C. Cabling system shall meet performance requirements of ANSI/TIA/EIA-568B, TIA/EIA TSB-67, and TIA/EIA TSB-95 including bandwidth and attenuation/loss channel requirements. The contractor shall submit test results that show the CAT 6 and 6A UTP cable performance.
- D. The warranty shall cover the replacement or repair of defective product(s) and labor for the replacement or repair of such defective product(s).
- E. Submit a statement, at notice to proceed, of any Contractor warranties in addition to the manufacturer's stated and supplied warranties. Submit at closeout signed copies of the Contractor provided warranties that are in in addition to manufacturer's stated and supplied warranties.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Manufacturers
  - 1. Belden
  - 2. Leviton (Berk-Tek)
  - 3. CommScope
  - 4. Corning
  - 5. General Cable
  - 6. Cooper B-Line.
  - 7. Ortronics
- B. The Contractor shall supply materials as described and shown.
- C. The Contractor shall supply all cabling necessary to interconnect all system equipment including equipment located in communications rooms.

### 2.2 OPTICAL FIBER GENERAL REQUIREMENTS

- A. Fiber optic cable shall be certified to meet all parts of EIA-455 and comply with the NEC.
  - 1. Cable installed in plenums or air-handling spaces shall meet UL 910 and shall be marked OFNP in accordance with the NEC.
  - 2. Riser cable shall meet UL 1666 and be marked OFNR in accordance with the NEC.
  - 3. Fiber optic patch cords shall be of the manufactured duplex type, and from the same manufacture as the termination hardware and cable to insure compatibility and performance. Field fabricated patch cords shall not be allowed.
  - 4. Proper bend radius shall be maintained throughout the entire run of cabling and at all termination locations.

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- B. All fiber optic cable shall utilize the appropriate sheath for the particular application. This shall be in accordance with ANSI/EIA/TIA-568-B standards. Any cable placed in space used as an air return or in any way connected with air handling plenums or building ventilation shall be low-smoke, fire retarding cable, and must comply with the National Electrical Code Articles 725, 760, and 800. No cabling shall be placed in plenums without written approval from TESD IT.
- C. Building Cables: Building cables shall meet the following requirements:
1. Plenum Rated - Plenum rated cable consisting of multiple fibers shall have a Plenum PVC outer jacket. Each group of fibers shall have a color-coded Low Smoke PVC buffer. The buffered fibers are organized in subunits of fibers, reinforced with aramid yarn for extra strength and surrounded with a color-coded Low Smoke tube. The cable and each subunit shall be UL listed and meet the NEC requirements for OFNP.
- D. Optical fiber conductors shall follow standard color code schemes. Fiber numbers and binders shall correspond to the color codes as follows:

Fiber/Binder No.	Color	Fiber/Binder No.	Color
1	Blue	7	Red
2	Orange	8	Black
3	Green	9	Yellow
4	Brown	10	Violet
5	Slate	11	Rose
6	White	12	Aqua

- E. Preparation for delivery: The fiber optic cable shall be shipped on reels in lengths as specified with a minimum overage of ten (10) percent.
1. The cable shall be wound on the reel so that unwinding can be done without kinking the cable.
  2. Two (2) meters of cable at both ends of the cable shall be accessible for testing.
  3. Marking: Each reel shall have a permanent label attached showing length, cable identification number, cable size, cable type, attenuation, bandwidth, and date of manufacture. Labels shall be water resistant and the writing on the labels shall be indelible.
- F. Unless otherwise specified, all fiber optic cables shall be installed in inner duct throughout the entire length of the cable run.
- G. The Contractor shall furnish and install optical fiber bundles as identified on the drawings.
- H. Fiber bundles shall not be spliced or patched at transition points from indoor to outdoor environments.
- I. Fiber bundles shall be installed end to end or “home run” whenever possible to minimize splicing and patching.
- J. Zero tensile stress shall be placed upon the fiber bundles during installation to eliminate micro-fractures within the glass.

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### 2.3 FIBER OPTIC CABLING

- A. All fibers must comply with TIA/EIA 492, ANSI/ICEA S-83-596, ANSI/TIA-568.3-D, NFPA 130, and Telcordia GR-409. Fiber must comply with TIA/EIA 455 and IEC 793 test methods for required attributes. Fibers shall have dual wavelength capability; transmitting at 1310 and 1550 nm ranges and shall be rated for use as riser cabling. The coating shall be mechanically strippable. All Single-Mode fibers must be appropriately rated for their application whether indoor or outdoor. The sheath color for all single mode riser and single mode plenum rated cables shall be yellow in color.
- B. OS2 Cable – Maximum attenuation – 0.4 dB/km at 1300 nm, 0.3 dB/km at 1550 nm.
- C. UL® listed.
- D. ISO 9001 Certified Manufacturer.
- E. Single mode fiber cable shall be Leviton loose-tube, armored indoor/outdoor, plenum rated, OS2 cable and 8.3um fiber: LTPK12B012-AB0403.

### 2.4 FIBER SPLICE MODULES

- A. Fiber splicing and closures: All splices shall be fusion unless specifically approved by TESD IT. The fiber splice module shall meet the following specifications:
  - 1. Mechanical
    - a. Joins single mode fibers.
    - b. Establishes a permanent mechanical splice.
    - c. May be used in outside plant and/or premises applications.
    - d. Accept 250 and 900 micron fibers.
    - e. Re-enterable, re-arrangeable, and reusable.
    - f. Require no polishing.
    - g. Require no adhesives.
    - h. No loose parts.
    - i. One part index matching gel.
    - j. Unlimited shelf life.
  - 2. Optical
    - a. Splice loss < 0.05 dB.
    - b. Reflection < 50 dB.
    - c. Stable from -40°F to 185°F (-40°C to 85°C).

### 2.5 BUNDLED FIBER ACCESSORIES

- A. Fiber Optic Termination Panels (FOTP).
  - 1. A suitable enclosure (FOTP) shall be provided at all locations where fiber is to be terminated.

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2. FOTPs shall provide for strain relief of incoming fiber as well as providing connector panels and connector couplings adequate to accommodate the number of fibers to be terminated.
3. All FOTPs shall incorporate radius control mechanisms to limit bending of the fibers to the manufacturer's recommended minimums or 3", whichever is larger.
4. FOTPs shall be wall or rack-mounted as specified in the drawings.
5. All terminated fibers shall be mated to LC couplings mounted on patch panels.
6. Couplers shall be mounted on a panel that, in turn, snaps into the housing assembly.
7. Panels shall be available to accommodate a changing variety of connector types.
8. All FOTPs shall have a common key lock that opens all FOTPs installed for this project.
9. The size of the FOTPs shall be coordinated with TESD IT for each location identified on the contract drawings.
10. The Contractor is responsible for selecting the FOTP hardware to meet site conditions.
11. Enclosure shall be equal to Ortronics 2U INFCO2U-M4 enclosure with OR-M2LCD12-50E multimode cassettes and OR-M2LCD12-09 single mode cassettes.

B. Optical Fiber Patch Cables

1. Optical fiber jumper connector types shall be coordinated and approved by TESD IT.
2. Optical fiber patch cables shall be factory-made. Field made fiber patch cords are not acceptable.
3. The connector body shall be of materials similar to that used in the proposed couplings.
4. Channels shall be of equal length.
5. The optical fiber patch cables shall be either single mode fiber utilizing tight buffer construction.
6. Coordinate fiber patch cord lengths with TESD IT. Fiber patch cord lengths shall be provided according to installation in a neat and workmanlike manner.
7. The Contractor shall provide all patch cords required to perform the patching as designated on the contract drawings and specifications. All slack in the patch cords shall be appropriately dressed using vertical and horizontal patch cord organizers to maintain a neat appearance.
8. The connector type(s) shall be LC Couplings.

The attenuation per mated pair shall not exceed 0.75 dB (individual) and 0.5 dB (average).

2.6 UTP CATEGORY 6 and 6A CABLE

- A. The contractor shall provide and install the appropriate Category 6 and fiber optic connectors, patch cables, connections and surge arrestors as required, including all testing.

B. Standards:

1. ANSI/TIA 568.2-D;
2. CSA C22.2 N° 214-02;
3. UL 444.
4. Plenum-NFPA 70, CMP
5. UL Listed as CMP-LP (0.7A)

C. UTP and Shielded Cables:

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1. Indoor CAT 6 (Cables for Data, Telephone): Equal to Leviton LANMARK 2000 series plenum rated White 10167311.
2. Indoor shielded CAT 6A (Cables for WAPs in/on exterior of buildings): Equal to Leviton LANMARK 10-G series plenum rated Blue 10143424.
3. Indoor CAT 6 (Cables for Cameras in/on buildings): Equal to Leviton LANMARK 2000 series plenum rated Purple/Violet 10170672.
4. Outdoor CAT 6 (Underground Cables): Equal to Leviton LANMARK 1000 OSP series Black 11072213.

## 2.7 UTP CABLE HARDWARE

- A. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher. All terminations shall use TIA/EIA 568B wire termination color coding.
  1. All interior cabling shall be plenum and clearly stamped with the CMP marker.
  2. All exterior cabling shall be outdoor rated with water proofing agents.
- B. Provide rack mounted 48 port, CAT 6 and 6A rated patch panels in new IDFs racks shown on the Contract Drawings, each RJ45 copper port shall have a space for port identification and the contractor shall uniquely identify each port. CAT 6 wire-management shall be provided on both sides of the patch panels. Provide a minimum of 25% spare capacity in each IDF or MDF rack patch panel installed under this project; final quantity of patch panels shall be determined by the contractor based on the jack/device symbols shown on the contract drawings.
  1. CAT6 patch panels: OR-PHD66U48.
  2. CAT 6A patch panels for WAPs: OR-PHD6AU24.
- C. Surge Protective Devices (SPD) for PoE Cameras: The PoE SPD shall be installed for all outdoor cameras (site and building mounted). Cabling from cameras shall terminate at the SPD prior to being patched to the switches. Provide Ditek #DTK-RM12POE or approved equal.
- D. Patch Cables: Factory-made and terminated UTP Category 6 and 6A cables for each Network Device to Patch Panel connections. Patch cables shall not exceed 12 inches in length, and shall be sized appropriately for the connection needed. Cable manufacturer shall match the UTP cable specified above.

## 2.8 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Patch Panels shall be modular to accept the category 6 data jacks for the horizontal cabling.
- B. Jacks and Jack Assemblies shall be of the same manufacturer of the UTP cabling, and shall be rated for category 6.
- C. Workstation Outlets: Two, Four, and Six-port modular connector assemblies mounted in single faceplate. Refer to detail drawings for configurations.
  1. Metal Faceplate: Stainless steel, complying with requirements
  2. For use with snap-in jacks accommodating UTP.
  3. Factory labeled by silk-screening or engraving for stainless steel faceplates.
  4. Machine printed, in the field, using adhesive-tape label.
  5. Snap-in, clear-label covers and machine-printed paper inserts.
  6. Category 6 jacks shall be equal to Ortronics CAT 6 jack, color to match cable.

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- D. Protector Blocks: Used for protection of outdoor station cables.
  - 1. Configuration of outdoor station cable protectors:
    - a. One 4-Pair UTP Category 6 solid-state protector.
    - b. Shall comply with TIA/EIA standards for Category 6 performance.
    - c. Shall be UL listed.

## 2.9 TELECOMMUNICATIONS EQUIPMENT

- A. Open Racks shall be equal to Ortronics: STANDARD EQUIPMENT RACK, 19" BLACK, 72.00"H, 3" CHANNEL, model #OR-19-72-T2SDB.
  - 1. Vertical cable management: Q-SERIES VERTICAL MANAGER, 7' H X 6" WIDE, DOUBLE SIDED, model #QVMD706.
  - 2. Horizontal cable management: 2U, model # OR-808004818.
  - 3. Ground the Rack with #4 AWG back to the main electrical room MDP.
- B. Closed, Wall-Mounted Racks shall be equal to Equal to Middle Atlantic DWR-18-26PD (18 rack units and 26" depth) rack with vented front door with lock with keys (VFD-18) and minimum-clearance latch.

## 2.10 SITE POLE CAMERA ENCLOSURES

- A. Stainless Steel enclosure by Saginaw Control & Engineering or approved equal.
  - 1. SCE-24H2008SSLP N4X with sub-panel SCE-24P20GALV.
  - 2. Emmerson SolaHD SDU 850B UPS with SDUEDC din rail clip and SDUECATCARD.
  - 3. UPS rotary disconnect on/off switch: Rated at 120V-20A.
  - 4. Receptacles: (1) Non-UPS 20A rated receptacle and (1) UPS-fed 20A rated receptacle.
  - 5. Din rails and hinged cover wireways, as required.
  - 6. Coordinate with SSI contractor prior to ordering/submitting.

## PART 3 - EXECUTION

### 3.1 EXAMINATION AND VERIFICATION

- A. Verify conduits, raceways, and boxes are properly installed following BICSI recommended practices and ANSI/TIA/EIA 569A standards.
- B. Verify conduit is minimum 1 -inch diameter.

### 3.2 INSTALLATION

- A. Install work following drawings, manufacturer's instructions, and approved submittal data. The number of cables per run, outlet configuration, and other pertinent data shall be included on the drawings.
- B. All installation shall be done in conformance with ANSI/TIA/EIA 568B and BICSI installation guidelines. The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded, and cable bends maintain the proper radius during the placement of the facilities. Failure to follow the appropriate guidelines shall require the Contractor to provide, in a timely fashion,

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the additional material and labor necessary to properly rectify the situation. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.

- C. All fibers shall be run in inner duct and terminated in the communications rooms with LC type connectors in wall, or rack mounted Fiber Optic Distribution Shelves equipped with enough panels, couplers and jumper storage shelves to terminate and secure all fibers.
- D. Riser and tie cables shall be extended between communications rooms utilizing the interfloor conduit sleeves.
- E. All components of the cabling system shall be installed in a neat and professional manner. Wiring color codes shall be strictly observed, and terminations shall be uniform throughout the installation. All cables shall be neatly dressed at the termination points. Final installation shall be subject to TESD IT approval. The cabling installation shall meet all applicable national and local codes pertaining to low voltage cable system installations.
- F. The Contractor shall adhere to the installation schedule approved by TESD IT and shall coordinate all construction meetings as agreed with TESD IT.
- G. The Contractor shall provide service loops (slack) for cables terminating in the main equipment room or the telecommunications rooms. A ten (10) foot service loop shall be provided above the access ceiling or cable trays unless specified otherwise.
- H. The installation shall include coordination, testing, and problem resolution with the system vendors.
- I. Upon completion of the installation, the Contractor shall prepare as-built documentation of the backbone cable installation. This documentation should include:
  - 1. Drawings.
  - 2. Documentation.
  - 3. This data shall be submitted prior to the use of any system components. System acceptance will not be provided without complete as-built documentation.
- J. Plastic cable ties shall not be used at any location within this project. All cables shall be bundled using Velcro wraps of the appropriate length. Velcro ties shall be installed in such a manner that cables may be easily removed or added to the cable bundle.

### 3.3 TESTING AND VERIFICATION

- A. General
  - 1. Communications Field Verification Services shall be required to complete the acceptance of the installation in a timely manner.
- B. Field Verification Team
  - 1. Must be supervised on-site by a BICSI RCDD. Must demonstrate knowledge and compliance with all BICSI, TIA/EIA, UL, and NEC standards and codes.
  - 2. All members of the field verification team must be certified by the manufacturer as having completed the necessary training to complete their part of the field verification. Resumes of the entire team shall be provided along with documentation of completed training courses.



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C. Field Verification Reports

1. After each inspection and test, the Contractor shall promptly submit 2 copies of field verification report.
2. Each report shall include:
  - a. Date Issued.
  - b. Project Title and number.
  - c. Project Phase of Testing.
  - d. Field Verification Contractor name, address and telephone number.
  - e. Name of inspector and job number.
  - f. Date and time of sampling or inspection.
  - g. Record of temperature and weather conditions.
  - h. Date of test.
  - i. Identification of specification section.
  - j. Location of test in the Project.
  - k. Cable ID where applicable.
  - l. Type of inspection or test.
  - m. Results of tests and compliance with Contract Documents.
  - n. Interpretation of test results.

D. Contractors Responsibilities

1. Provide incidental labor and facilities to provide access to work to be tested, to facilitate tests and inspections, and for storage of test equipment.
2. Notify TESD IT (1) week prior to expected time for operations requiring inspection and testing services.
  - a. When tests or inspections cannot be performed after such notice, the Contractor shall notify TESD IT.

E. Payment for Testing

1. Retesting:
  - a. When initial tests indicate non-compliance with the Contract Documents, all subsequent retesting occasioned by the non-compliances shall be performed by Contractor and the costs thereof will be borne by the Contractor.
2. Contractor's Convenience Testing:
  - a. Inspecting and testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor.

F. Code Compliance Testing

1. Inspections and tests required by codes or ordinances, or by a plan approval authority having jurisdiction over the project site, and which are made by a legally constituted authority, shall be

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the responsibility of and shall be paid for by the Contractor, unless otherwise provided in the Contract Documents.

### 3.4 UTP CABLE TESTING

- A. Certification: Test all network outlets and equipment to the maximum specified performance capability. Provide a report listing each network and telephone outlet location and certify its satisfactory performance in compliance with the specifications.
- B. All UTP cabling will be certified to meet and or exceed the Category 6 or 6A specifications as set forth in TIA/EIA-568-B.2-1 using field testers. All Cat 6 and 6A cables must be tested with Fluke DTX-1800 or equivalent.
- C. Certifications shall include the following parameters for each pair of each cable installed:
  - 1. Wire map (pin to pin connectivity)
  - 2. Length (in feet)
  - 3. Attenuation
  - 4. Near End Crosstalk (NEXT)
  - 5. Far End Crosstalk (FEXT)
  - 6. ELFEXT
  - 7. Attenuation/Crosstalk Ratio (ACR)
  - 8. Return Loss
  - 9. Propagation Delay
  - 10. Delay Skew
- D. Test equipment shall provide an electronic and printed record of these tests.
- E. Owner reserves the right to hire an independent testing company to spot check the test results. If the results vary more than 10% from the results provided by the Contractor, the Contractor will be required to prove his results are correct or retest the entire system.

### 3.5 FIBER OPTIC TESTING

- A. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing. A TESD representative will witness all field tests.
- B. Factory Test: Prior to shipment of the fiber optic cable, 100 percent of the fibers shall be tested with an Optical Time Domain Reflectometer (OTDR) at 1310/1550 nm for single-mode fiber. The OTDR shall be calibrated to show anomalies of 0.2 dB as a minimum. All information and supporting data of factory testing for each strand of fiber shall be furnished to the TESD as support documentation for before and after installation data.
- C. Contractor's Field Test: The Contractor shall verify the complete operation of any provided data transmission equipment during the Contractor's field testing. Tests shall be performed on 100 percent of the fibers of each circuit and repeated from the opposite end of each circuit. Field tests shall include as a minimum:
  - 1. An OTDR test will be performed from both directions using a 300 meter launch cable for single mode fiber. Single-Mode fiber shall be tested at 1310 nm and 1550 nm. Tests shall be calibrated to show length, transmission anomalies (0.2 dB as a minimum) and end-to-end attenuation. If the OTDR test results are unsatisfactory; the FO cable segment is unacceptable to the TESD. The

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unsatisfactory segments of cable shall be replaced with a new segment of cable at no cost to the TESD. The new segment of cable shall then be tested to demonstrate acceptability. Test results shall be furnished by the contractor for each circuit installed and provided to the TESD.

2. After termination and bulkhead mounting, each terminated fiber is to be tested for end-to-end loss with a power meter/light source. Power attenuation test shall be performed in the 1310 nm and 1550 nm for single mode wavelength band of the transmitter to be used on the circuit being tested. The flux shall be measured at the fiber optic receiver end and shall be compared to the flux injected at the transmitter end. There shall be a jumper added at each end of the circuit under test so that end connector loss shall be validated. Rotational optimization of the connectors will not be permitted. The circuit loss shall not exceed the calculated circuit loss by more than 1 dB. If the test is unsatisfactory, the circuit shall be examined to determine the problem. The TESD shall be notified of the problem and what procedures the Contractor proposes to eliminate the problem. The Contractor shall prepare a report documenting the results of the test.
- D. The insertion loss for each mated fiber optic connector pair shall be  $\leq 0.75$  dB. Reflectance for single-mode single fiber UPC cable assemblies shall be  $\leq -55$  dB. Mated connector pair loss testing shall be based on one unidirectional OTDR inspection in accordance with the OTDR operating manual for systems greater than 300 feet.
- E. In addition to connector insertion loss for each mated pair, the contractor shall perform end-to-end insertion loss testing for each single-mode fiber at 1310 nm and 1550 nm from one direction for each terminated fiber span in accordance with TIA-526-7 (OFSTP 7). For spans greater than 90 meters, each tested span must test to a value less than or equal to the value determined by calculating a link loss budget. Each tested span shall be  $\leq 1.0$  dB for inside plant and  $\leq 0.5$  dB for outside plant. For horizontal spans less than or equal to 90 meters, each tested span must be  $\leq 2.0$  dB.
- F. Inspect each terminated single-mode fiber span for continuity and anomalies with an OTDR at 1550 nm from one direction in accordance with OTDR operating manual for systems greater than 300 feet.
- G. Test fiber strands for Optical Return Loss (ORL). All fiber's must conform to Corning Cable Systems internal specification to ensure that any fiber reflections present have an ORL  $> -60$  dB.
- H. After termination and bulkhead mounting, each terminated fiber is to be tested for end-to-end (including patch chord) loss with a power meter/light source. Power attenuation test shall be performed in the 1310 nm and 1550 nm for single mode wavelength band of the transmitter to be used on the circuit being tested. The flux shall be measured at the FO receiver end and shall be compared to the flux injected at the transmitter end. There shall be a jumper added at each end of the circuit under test so that end connector loss shall be validated. Rotational optimization of the connectors will not be permitted. The circuit loss shall not exceed the calculated circuit loss by more than 5 dB in total.
- I. The Contractor shall coordinate with the Network contractor to ensure that the channel (existing and new fiber optic cabling) supporting the network uplink switch connections is less than 5 dB loss from end-to-end. If the connection is found to be greater than 5 dB loss, the Contractor shall provide the maintenance/repairs necessary to ensure that the connection meets requirement.
- J. Submit fiber optic cable test reports to the engineer for review and approval.

END OF SECTION 271000

## SECTION 27 11 26 – COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes
  - 1. Uninterruptible power supplies.
  - 2. Temperature and humidity sensors.
  - 3. Power cords.
  - 4. Power distribution units.
  - 5. Installation.
- B. Related Requirements
  - 1. Section 27 05 00 Common Work Results for Communications
  - 2. Section 27 21 29 Data Communications Switches
  - 3. Section 27 21 33 Data Communications Wireless Access Points
  - 4. Section 27 26 23 Network Programming and Integration Requirements
- C. Narrative: The design intent of this section is to provide protected electrical power at each of six telecommunications spaces (DFs)—one (1) MDF and five (5) IDFs—for indoor and outdoor WAPs, wired switches for twisted-pair copper connectivity with support for PoE, and other PoE-powered devices such as CCTV security cameras and VoIP handsets.

#### 1.2 REFERENCES

- A. Abbreviations and Acronyms
  - 1. BoD: Basis of Design
  - 2. Cat: Category (cable)
  - 3. CCTV: Closed-Circuit Television
  - 4. DF: Data Frame
  - 5. EC: Electrical Contractor
  - 6. IDF: Intermediate Distribution Frame
  - 7. IP: Internet Protocol
  - 8. MDF: Main Distribution Frame
  - 9. PDU: Power Distribution Unit
  - 10. PoE: Power-over-Ethernet
  - 11. SSI: Security System Installer
  - 12. STP: Shielded Twisted Pair
  - 13. UPS: Uninterruptible Power Supply
  - 14. UTP: Unshielded Twisted Pair
  - 15. VoIP: Voice-over-IP
  - 16. WAP: Wireless Access Point

B. Reference Standards

1. NFPA 70 National Electrical Code
  - a. As amended and adopted by the AHJ, if applicable.
  - b. 2023 edition, otherwise.
2. TIA-568.0-E.1 Generic Telecommunications Cabling for Customer Premises
3. TIA-568.2-D.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standard
4. TIA-569-E.1 Telecommunications Pathway and Spaces
5. TIA-607-D.1 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
6. TIA-862-C Structured Cabling Infrastructure Standard for Intelligent Building Systems
7. UL 308 Subject for Power Distribution Units, edition 1
8. UL 467 Grounding and Bonding Equipment, edition 11
9. UL 1778 Uninterruptible Power Systems, edition 5
10. UL 1989 Standard for Standby Batteries, edition 5
11. UL 2239 Hardware for the Support of Conduit, Tubing, and Cable, edition 2
12. UL 9990 Information and Communication Technology (ICT) Power Cables, edition 1
13. OSHA Standards - 29 CFR Sections 1910 and 1926
14. ANSI/NEMA 250-2020 Enclosures for Electrical Equipment (1,000 Volts Maximum)
15. ANSI/BICSI 001-2017 R22 Information and Communication Technology Systems Design and Implementation Best Practices for Educational Institutions and Facilities
16. ANSI/BICSI N1-2019 Installation Practices for the Installation of Telecommunications and ICT Cabling and Related Cabling Infrastructure

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Coordinate final installation location and mounting requirements with EC and SSI.
2. Coordinate network programming and integration per section 27 26 23, including Ethernet patch panel uplink port assignments, identification, and labeling with Owner.

B. Preinstallation Meetings: Arrange preinstallation meeting at least 1 week prior to commencing work with all parties associated with trade or as requested by Engineer. Presided over by Contractor, include Engineer who may attend, Subcontractor performing work of this trade, Owner's representative, and EC.

C. Sequencing

1. Commence physical installation after EC has installed technology racks at MDF and IDF locations and electrical service is ready for use in the space.
2. Complete physical installation under this section prior to installation of switches per section 27 21 29 and wireless access points per section 27 21 33.
3. Commence network programming and integration per section 27 26 23 after sufficient network connectivity has been established to the TESD NOC.

1.4 ACTION SUBMITTALS

A. Product data: For each type of product.

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- B. Shop Drawings:
  - 1. Rack elevations for each DF showing intended layout of UPS, PDU(s), transformer (if applicable), and sensor.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Test and Evaluation Reports:
  - 1. For each UPS, submit results of a comprehensive self-test following installation.
  - 2. For each DF, submit digital photographs showing the completed work, including: a full view of the rack from the front, close-up views of each component installed under this section, and side or rear views as access permits.
- B. Manufacturer Reports: For each UPS, submit factory test report.

## 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Contracts: For each UPS.
- B. Warranty Documentation: For each product type.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT

- A. UPS: Double-conversion on-line pure sine rackmount; network management compatible with existing TESD network management software system. Provide (1) UPS per telecommunications rack at each DF. Coordinate final UPS capacity and quantity with EC.
  - 1. Products:
    - a. APC Smart-UPS SRT 3000VA RM 208V (SRT3000RMXLT-NC)
    - b. APC Smart-UPS SRT 5000VA RM 208V (SRT5KRMXLT)
  - 2. BoD quantity and sizing:
    - a. MDF: (2) 3000VA
    - b. IDF 1A: (1) 3000VA
    - c. IDF 2A: (1) 3000VA
    - d. IDF 2B: (1) 3000VA
    - e. IDF 3A: (1) 3000VA
    - f. IDF 3B: (1) 3000VA
- B. Transformer: Provide (1) step-down transformer per telecommunications rack at each DF.
  - 1. Products: APC Smart-UPS RT Tower Isolation/Step-Down Transformer (SURT003)

### 2.2 ACCESSORIES

- A. Temperature and humidity sensor: Provide (1) at each DF.

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1. Products: APC Temperature & Humidity Sensor (AP9335TH)
- B. Power cords
  1. Products: Provide compatible units in required quantities at each DF.
    - a. Power Cord, Locking C19 to L6-20P, 3.0m (AP8753)
- C. PDU:
  1. Products: Provide compatible units in required quantities at each DF.
    - a. Rack PDU, basic, 0U/1U, 100-240V/20A, 220-240V/16A, (13) C13 (AP6020A)

## 2.3 MISCELLANEOUS MATERIALS

- A. Ethernet patch cables: Cat 6 or Cat 6A, STP, solid conductor, strain relief/anti-snag boot.
  1. Select cable lengths that are no greater than necessary for each connection while allowing sufficient working slack and respecting strain relief and bend radius limits.
- B. Fasteners, brackets, rails, tape, ties, wraps, labels, and other miscellaneous hardware and supplies as necessary are the responsibility of the Contractor.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verification of Conditions: Visit site prior to finalizing installation details such as accessories, installation methods, and miscellaneous materials. Verify in the field the exact locations of existing infrastructure and equipment, mounting surfaces and attachment points, supports, dimensions, access, clearance, and electrical service.

### 3.2 PREPARATION

- A. Cleanliness: Remove dust and debris from the work area prior to removing products from original packaging.

### 3.3 INSTALLATION

- A. Install/mount equipment securely according to manufacturer's instructions, applicable reference standards, and approved shop drawings.
  1. Connect sensor to UPS.
  2. Connect power cords and PDUs to UPS.
  3. Connect step-down transformer to UPS.
  4. Connect network management Ethernet patch cable to UPS, coiled neatly and secured.
- B. Dress in all cabling using rack members and horizontal and vertical cable management as available.

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1. Avoid routing cables via rack members and faces that would create an obstruction for the installation of other equipment.
  2. Take up slack in data communications and sensor cable with figure-eight coils. Avoid violating minimum bend radii limits.
  3. Take up slack in electrical cables with figure-eight coils or flat Z-folds.
- C. Secure data communications and sensor cable with hook-and-loop wraps.
- D. Secure electrical cables with zip ties. Trim the excess tie leader flush with the ratchet.
- E. Apply identification labels to equipment and cables.

### 3.4 FIELD QUALITY CONTROL

- A. Acceptance testing:
1. Energize the UPS, verify correct start-up and absence of any fault indications.
  2. For each downstream PDU, verify that the PDU is energized.
  3. Apply a load of at least 100W that affords immediate indication when energized and deenergized (provided by Contractor), disconnect service for 3 minutes, and verify successful transfer to and from battery.
- B. Capture the photographs required by Paragraph 1.5A.2 on the same day the installation is completed at each DF.

### 3.5 CLEANING

- A. Cleanliness: Remove dust and debris from the work area. Remove packaging. Deliver unused parts to the NOC.

END OF SECTION



## SECTION 27 21 29 – DATA COMMUNICATIONS SWITCHES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes
  - 1. Ethernet switches.
  - 2. DAC cables.
  - 3. Optical transceivers.
  - 4. Copper and fiber-optic patch cables and jumpers.
  - 5. Installation.
- B. Products Furnished But Not Installed Under This Section
  - 1. For each product not already represented in Owner's existing maintenance replacement inventory, furnish (1).
- C. Related Requirements
  - 1. Section 27 05 00 Common Work Results for Communications
  - 2. Section 27 11 26 Communications Rack Mounted Power Protection and Power Strips
  - 3. Section 27 21 33 Data Communications Wireless Access Points
  - 4. Section 27 26 23 Network Programming and Integration Requirements
- D. Narrative: The design intent of this section is to provide distribution-layer network connectivity at a telecommunications space (MDF) where OSP fiber optic infrastructure enters the premises, and access-layer network connectivity at each of six telecommunications spaces (one MDF and five IDFs) for indoor and outdoor WAPs, CCTV security cameras, VoIP handsets, HVAC controllers, smart boards, UPS management, and other wired network hosts. Each space is to be equipped with at least one switch capable of providing copper connectivity at up to 5 Gb/s per port with PoE up to 90 W on certain ports. Where two or more access-layer switches or two distribution-layer switches are installed in the same technology rack, all switches of the same role (access or distribution) are to be connected to each other in a ring with high-speed DAC cables to enable configuration as a single, logical stack. Each IDF is to be connected upstream to the distribution-layer switches at the MDF via redundant 10 Gb/s links across duplex SMF. The MDF is to be connected upstream to the existing core switches at the NOC via redundant 40 Gb/s links across duplex SMF. Fiber-optic connections over MMF are not covered by this design.

#### 1.2 REFERENCES

- A. Abbreviations and Acronyms
  - 1. Cat: Category (cable)
  - 2. CCTV: Closed-Circuit Television
  - 3. DAC: Direct Attached Copper
  - 4. EC: Electrical Contractor
  - 5. HVAC: Heating, Ventilation, and Air Conditioning

6. IDF: Intermediate Distribution Frame
7. IP: Internet Protocol
8. MDF: Main Distribution Frame
9. MMF: Multi-Mode Fiber
10. NOS: Network Operating System
11. OSP: Outside Plant
12. PDU: Power Distribution Unit
13. PoE: Power-over-Ethernet
14. PoS: Point-of-Sale
15. PSU: Power Supply Unit
16. SFP: Small Form-factor Pluggable
17. SKU: Stock Keeping Unit
18. SMF: Single-Mode Fiber
19. SSI: Security System Installer
20. STP: Shielded Twisted Pair
21. UPS: Uninterruptible Power Supply
22. UTP: Unshielded Twisted Pair
23. VoIP: Voice-over-IP
24. WAP: Wireless Access Point

B. Reference Standards

1. NFPA 70 National Electrical Code
  - a. As amended and adopted by the AHJ, if applicable.
  - b. 2023 edition, otherwise.
2. TIA-568.0-E.1 Generic Telecommunications Cabling for Customer Premises
3. TIA-568.2-D.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standard
4. TIA-568.3-E Optical Fiber Cabling and Components Standard
5. TIA-568-E.1 Telecommunications Pathway and Spaces
6. TIA-607-D.1 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
7. TIA-862-C Structured Cabling Infrastructure Standard for Intelligent Building Systems
8. UL 2239 Hardware for the Support of Conduit, Tubing, and Cable, edition 2
9. UL 9990 Information and Communication Technology (ICT) Power Cables, edition 1
10. UL 62368-1 Audio/Video, Information and Communication Technology Equipment - Part 1: Safety Requirements, edition 3
11. OSHA Standards - 29 CFR Sections 1910 and 1926
12. ANSI/NEMA 250-2020 Enclosures for Electrical Equipment (1,000 Volts Maximum)
13. ANSI/BICSI 001-2017 R22 Information and Communication Technology Systems Design and Implementation Best Practices for Educational Institutions and Facilities
14. ANSI/BICSI N1-2019 Installation Practices for the Installation of Telecommunications and ICT Cabling and Related Cabling Infrastructure
15. ANSI/BICSI N2-17 Practices for the Installation of Telecommunications and ICT Cabling Intended to Support Remote Power Applications
16. ANSI/BICSI N3-20 Planning and Installation Methods for the Bonding and Grounding of Telecommunication and ICT Systems and Infrastructure

### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination
  - 1. Coordinate final access port count and type at each DF with EC.
  - 2. Coordinate final installation location and mounting requirements with EC.
  - 3. Coordinate network programming and integration per section 27 26 23, including Ethernet patch panel and fiber termination panel uplink port assignments, identification, and labeling with Owner.
- B. Preinstallation Meetings: Arrange preinstallation meeting at least 1 week prior to commencing work with all parties associated with trade or as requested by Engineer. Presided over by Contractor, include Engineer who may attend, Subcontractor performing work of this trade, Owner's representative, and EC.
- C. Sequencing
  - 1. Commence physical installation after UPS installation under section 27 11 26 has been completed.
  - 2. Complete physical installation under this section prior to installation of wireless access points per section 27 21 33.
  - 3. Commence network programming and integration per section 27 26 23 after sufficient network connectivity has been established to the TESD NOC.

### 1.4 ACTION SUBMITTALS

- A. Product data: For each type of product.
- B. Shop Drawings:
  - 1. Rack elevations for each DF showing intended layout of switches.
  - 2. Switch-port to patch panel and to fiber termination panel port map inventory list.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Test and Evaluation Reports:
  - 1. For each DF, submit digital photographs showing the completed work, including: a full view of the rack from the front, close-up views of each component installed under this section, and side or rear views as access permits.

### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Contracts: For each switch.
- B. Warranty Documentation: For each product type.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare Parts: Furnish in original packaging to NOC.
  - 1. (1) of each approved equal product from Article 2.1.
  - 2. (1) of each approved equal product from Article 2.2.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Ethernet distribution switches:
  - 1. Products: Provide (2) switches to the MDF with Advanced Features enabled and covered by next-business day support for a duration of 5 years. Switch power cables shall connect to C13 PDU receptacles.
    - a. Juniper EX4600 (EX4600-40F-AFO)
    - b. Juniper EX4600 Advanced Feature License (EX4600-AFL)
    - c. Juniper Care Next Business Day Support, 5 yr (SVC-ND-EX460040F-5YR)
- B. Ethernet access switches:
  - 1. Products: Provide (1) JL659A to each DF. Additional port density, where required, is to be satisfied with JL661A. Switch power cables shall connect to C13 PDU receptacles.
    - a. Aruba 6300M 48G CL4 PoE 4SFP56 Switch (JL661A)
    - b. Aruba 6300M 48SR5 CL6 PoE 4SFP56 Switch (JL659A)
- C. Switch components:
  - 1. Products: Provide redundant PSUs and fan trays in each access switch.
    - a. Aruba X372 54VDC 1050W Power Supply (JL087A)
    - b. Aruba 6300M Fan Tray (JL669A)
- D. Substitution Limitations: The existing installed base of data communications switches throughout Owner's network is comprised of Aruba model JL661A and JL659A devices for the access layer, Juniper model EX4600 for the distribution layer, and Juniper model EX9204 devices with model EX9200-12QS multi-rate line cards for the core. Approved equals must be fully compatible with all existing network management systems, configuration standards and methods, and operational practices.

2.2 FIBER-OPTIC PORT ATTACHMENTS

- A. Transceivers:
  - 1. Products: Provide (4) 10 Gb/s transceivers per DF for uplink to distribution switches at MDF, matching SKU to device in each location; provide (2) 40 Gb/s transceivers to the distribution switches at the MDF; provide (2) 40 Gb/s transceivers to the existing core switches at the NOC.
    - a. Aruba 10G SFP+ LC LR 10km SMF Transceiver (J9151E)
    - b. Juniper SFP+ 10GBASE-LR LC 10 km SMF (EX-SFP-10GE-LR)
    - c. Juniper QSFP+ 40GBASE-LR4 LC 10km SMF (JNP-QSFP-40G-LR4)

- d. Juniper QSFP+ 40GE LR4 (QSFP-40GBASE-LR4)
- B. DAC cables:
  - 1. Products: Provide (1) DAC cable per access switch; provide (1) DAC cable per distribution switch.
    - a. Aruba 50G SFP56 to SFP56 0.65m DAC Cable (R0M46A)
    - b. Aruba 50G SFP56 to SFP56 3m DAC Cable (R0M47A)
    - c. Juniper QSFP+ 40G DAC, 1m (QFX-QSFP-DAC-1M)
- C. Substitution Limitations: Approved equals must be certified by the Contractor to function correctly and perform fully when installed in the intended switch equipment with the NOS version as specified in section 27 26 23, including functions that enable remote read-out of model and serial numbers, and monitoring of transceiver heat, electrical current, and optical transmit and receive power levels. Contractor shall further provide on each approved equal a warranty of the same duration and coverage as the corresponding manufacturer warranty on the first-listed manufacturer products listed herein. If an approved equal product fails to perform or function correctly within the warranty period, Owner shall be entitled at Owner's sole discretion to require Contractor to replace it at no additional cost with a new corresponding first-listed manufacturer product as listed herein.

## 2.3 MISCELLANEOUS MATERIALS

- A. Ethernet patch cables: Cat 6 or Cat 6A, STP, solid conductor, strain relief/anti-snag boot.
  - 1. Select cable lengths that are no greater than necessary for each connection while allowing sufficient working slack and respecting strain relief and bend radius limits.
- B. Fiber-optic patch cables: Corning-certified, duplex SMF (OS2), LC/LC UPC.
  - 1. Select cable lengths that are no greater than necessary for each connection while allowing sufficient working slack and respecting strain relief and bend radius limits.
- C. Fasteners, brackets, rails, tape, ties, wraps, labels, and other hardware and supplies as necessary are the responsibility of the Contractor.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verification of Conditions: Visit site prior to finalizing installation details such as patch cable quantities and lengths. Verify in the field the exact locations of existing infrastructure and equipment, mounting surfaces and attachment points, supports, dimensions, access, clearance, and electrical service.

### 3.2 PREPARATION

- A. Cleanliness: Remove dust and debris from the work area prior to removing products from original packaging.

### 3.3 INSTALLATION

- A. Install/mount equipment securely according to manufacturer's instructions, applicable reference standards, and approved shop drawings.
  - 1. Leave each protective rubber plug installed in switch until immediately prior to installing a DAC cable or transceiver into the cage.
  - 2. Energize all redundant PSUs.
  - 3. Connect DAC cables to form stack ring of distribution switches.
  - 4. Connect DAC cables to form stack ring of access switches. Use 0.65 m cable for adjacent switches. Use 3 m cable for top-most to bottom-most switch, if necessary, 0.65 m cable otherwise.
  - 5. Install all Cat 6/6A patch cables.
  - 6. Install all fiber-optic transceivers. Leave each protective rubber plug installed in the transceiver until immediately prior to connecting the fiber-optic cable.
  - 7. Connect all fiber-optic patch cables and jumpers. Leave each protective plastic cap installed on the fiber tip until immediately prior to connecting it to a transceiver or patch panel.
  - 8. Connect all copper patch cables and jumpers.
- B. Dress in all cabling using rack members and horizontal and vertical cable management as available.
  - 1. Avoid routing cables via rack members and faces that would create an obstruction for the installation of other equipment.
  - 2. Take up slack in data communications cable with figure-eight coils. Avoid violating minimum bend radii limits.
  - 3. Take up slack in electrical cables with figure-eight coils or flat Z-folds.
- C. Secure copper and fiber-optic data communications cable with hook-and-loop wraps. Avoid bundling different cable types together.
- D. Secure electrical cables with zip ties. Trim the excess tie leader flush with the ratchet.
- E. Apply identification labels to equipment and cables.

### 3.4 FIELD QUALITY CONTROL

- A. Acceptance testing:
  - 1. For each switch, connect to serial console management port (with Contractor-supplied adapter and terminal) to verify correct start-up and absence of any fault indications.
- B. Capture the photographs required by Paragraph 1.5A.1 on the same day the installation is completed at each DF.

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3.5 CLEANING

- A. Cleanliness: Remove dust and debris from the work area. Remove packaging. Deliver unused parts to the NOC.

END OF SECTION

## SECTION 27 21 33 – DATA COMMUNICATIONS WIRELESS ACCESS POINTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes
  - 1. Wireless access points.
  - 2. Mounting brackets.
  - 3. Optical transceivers.
  - 4. Installation.
- B. Related Requirements
  - 1. Section 27 05 00 Common Work Results for Communications
  - 2. Section 27 21 29 Data Communications Switches
  - 3. Section 27 26 23 Network Programming and Integration Requirements
- C. Narrative: The design intent of this section is to provide indoor and outdoor wireless LAN coverage and connectivity for teaching and administrative staff, as well as for students, families, guests, and visitors. Indoor coverage is to include all areas of the premises. Outdoor coverage is to include the bus dismissal and car line areas in the front and back of the building. Indoor WAPs are to be ceiling mounted except for the four in the gymnasium which are to be wall mounted. Outdoor WAPs are to be mounted on the outside wall of the building. All WAPs are to be connected via PoE-over-Cat 6A.

#### 1.2 REFERENCES

- A. Abbreviations and Acronyms
  - 1. Approx: Approximate
  - 2. BSSID: Basic Service Set Identifier
  - 3. Cat: Category (cable)
  - 4. EC: Electrical Contractor
  - 5. IDF: Intermediate Distribution Frame
  - 6. IP: Internet Protocol
  - 7. J-box: junction box
  - 8. LAN: Local Area Network
  - 9. PoE: Power-over-Ethernet
  - 10. SMF: Single-mode Fiber
  - 11. STP: Shielded Twisted Pair
  - 12. UTP: Unshielded Twisted Pair
  - 13. VAC: Volts Alternating Current
  - 14. WAP: Wireless Access Point
- B. Reference Standards
  - 1. NFPA 70 National Electrical Code



- a. As amended and adopted by the AHJ, if applicable.
  - b. 2023 edition, otherwise.
2. TIA-568.0-E.1 Generic Telecommunications Cabling for Customer Premises
3. TIA-568.1-E.1 Commercial Building Telecommunications Infrastructure Standard
4. TIA-568.2-D.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standard
5. TIA-568.3-E Optical Fiber Cabling and Components Standard
6. TIA-568-E.1 Telecommunications Pathway and Spaces
7. TIA-607-D.1 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
8. TIA-862-C Structured Cabling Infrastructure Standard for Intelligent Building Systems
9. UL 1 Standard for Flexible Metal Conduit, edition 11
10. UL 4 Standard for Armored Cable, edition 15
11. UL 5 Standard for Surface Metal Raceways and Fittings, edition 15
12. UL 5A Nonmetallic Surface Raceways and Fittings, edition 4
13. UL 6 Electrical Rigid Metal Conduit – Steel, edition 15
14. UL 6A Standard for Electrical Rigid Metal Conduit, edition 2
15. UL 62 Flexible Cords and Cables, edition 20
16. UL 444 Communications Cables, edition 5
17. UL 1652 Flexible Metallic Tubing, edition 3
18. UL 1653 Electrical Nonmetallic Tubing, edition 3
19. UL 2239 Hardware for the Support of Conduit, Tubing, and Cable, edition 2
20. UL 9990 Information and Communication Technology (ICT) Power Cables, edition 1
21. OSHA Standards - 29 CFR Sections 1910 and 1926
22. ANSI/NEMA 250-2020 Enclosures for Electrical Equipment (1,000 Volts Maximum)
23. ANSI/BICSI 001-2017 R22 Information and Communication Technology Systems Design and Implementation Best Practices for Educational Institutions and Facilities
24. ANSI/BICSI 008-2018 Wireless Local Area Network (WLAN) Systems Design and Implementation Best Practices
25. ANSI/BICSI N1-2019 Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure
26. ANSI/BICSI N2-17 Practices for the Installation of Telecommunications and ICT Cabling Intended to Support Remote Power Applications
27. ANSI/BICSI N3-20 Planning and Installation Methods for the Bonding and Grounding of Telecommunication and ICT Systems and Infrastructure

### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination
  1. Coordinate final installation locations, dimensions, and mounting requirements with EC. For building mounted WAPs, coordinate final data cabling terminations and connection requirements.
  2. Coordinate identification and labeling with Owner.
- B. Preinstallation Meetings: Arrange preinstallation meeting at least 1 week prior to commencing work with all parties associated with trade or as requested by Engineer. Presided over by Contractor, include Engineer who may attend, Subcontractor performing work of this trade, Owner's representative, and EC.

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- C. Sequencing
  - 1. Contractor is responsible for all sequencing and schedule.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Test and Evaluation Reports:
  - 1. For each installed WAP, submit digital photographs showing the completed work, at least to include: a wide view showing the installation context of the WAP (room, pole, building, or structure), and close-up views of each component installed under this section. Ensure that each photograph can be unambiguously matched with its subject or subjects (e.g. by room number and plan direction).
- B. Inventory: BSSID/serial-number by installed floor, room number, and plan direction (if necessary to distinguish between multiple in the same room).

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Contracts: For each WAP.
- B. Warranty Documentation: For each product type.

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT

- A. WAPs: Indoor and outdoor, dual-band, Wi-Fi 6E (802.11ax) and Wi-Fi 7 (802.11be) access points compatible with existing TESD wireless network controller-based infrastructure and management platform. Provide (78) AP-735 and (4) AP-675.
  - 1. Products:
    - a. HPE Aruba Networking AP-735 (US) Tri Radio 2x2 Wi-Fi 7 Internal Antennas Campus Access Point (S1G43A)
    - b. HPE Aruba Networking AP-675 (US) Tri Radio 2x2 Wi-Fi 6E Internal Omni-Directional Outdoor AP (S0P50A)

#### 2.2 ACCESSORIES

- A. Mounting brackets: Provide (1) for each WAP as necessary by mounting location.
  - 1. Products:

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- a. AP-MNT-MP10-A Campus AP mount bracket kit (10-pack) type A: suspended ceiling rail, flat 9/16 (JZ370A)
- b. AP-MNT-MP10-B Campus AP mount bracket kit (10-pack) type B: suspended ceiling rail, flat 15/16 (Q9G69A)
- c. AP-MNT-MP10-B1 Campus AP mount bracket kit (10-pack) type B1: suspended ceiling rail, flat 15/16 thick (R6T34A)
- d. AP-MNT-MP10-C Campus AP mount bracket kit (10-pack) type C: suspended ceiling rail, profile 9/16 (Q9G70A)
- e. AP-MNT-MP10-D Campus AP mount bracket kit (10-pack) type D: solid surface (Q9G71A)
- f. AP-MNT-MP10-E Campus AP mount bracket kit (10-pack) type E: wall-box (R1C72A)
- g. HPE Aruba Networking AP-MNT-MP10-U Campus AP 10-Pack Universal Mount Bracket Kit (S0J40A)
- h. AP-MNT-MP10-X Campus AP mount adapter kit (10-pack) for existing W2/W3 mounts (R3T20A)
- i. AP-MNT-A Campus AP mount bracket kit (individual) type A: suspended ceiling rail, flat 9/16 (R3J15A)
- j. AP-MNT-B Campus AP mount bracket kit (individual) type B: suspended ceiling rail, flat 15/16 (R3J16A)
- k. AP-MNT-C Campus AP mount bracket kit (individual) type C: suspended ceiling rail, profile 9/16 (R3J17A)
- l. AP-MNT-D Campus AP mount bracket kit (individual) type D: solid surface (R3J18A)
- m. AP-MNT-E Campus AP mount bracket kit (individual) type E: wall-box (R3J19A)
- n. AP-OUT-MNT-V1A Outdoor Pole/Wall Long Mount Kit (R9H97A)
- o. AP-270-MNT-H1 AP-270 Series Outdoor AP Hanging or Tilt Install Mount Kit (JW054A)
- p. AP-270-MNT-H2 AP-270 Series Access Flush Wall or Ceiling Mount (JW055A)
- q. AP-270-MNT-H3 AP-270 Series Outdoor AP Hanging or Dual-Tilt Install Mount Kit (R6W11A)

## 2.3 MISCELLANEOUS MATERIALS

- A. Copper Ethernet patch cables: Cat 6 or Cat 6A, STP, solid conductor, strain relief/anti-snag boot. For each outdoor mounting location, patch cable shall be industrial temperature rated.
  1. Select cable lengths that are no greater than necessary for each connection while allowing sufficient working slack and respecting strain relief and bend radius limits.
- B. Fasteners, fittings, brackets, rails, tape, ties, wraps, clamps, flexible conduit, labels, and other miscellaneous hardware and supplies as necessary are the responsibility of the Contractor.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verification of Conditions: Visit site prior to finalizing installation details such as accessories, installation methods, and miscellaneous materials. Verify in the field the exact locations of existing infrastructure and equipment, mounting surfaces and attachment points, supports, dimensions, access, clearance, and electrical service.

### 3.2 PREPARATION

- A. Cleanliness: Remove dust and debris from the work area prior to removing products from original packaging.

### 3.3 INDOOR INSTALLATION

- A. Install/mount equipment securely according to manufacturer's instructions, applicable reference standards, and approved shop drawings.
  - 1. Install mounting bracket.
  - 2. Connect patch cable.
  - 3. Dress in cable with figure-eight coil if necessary to take up slack.
  - 4. Secure cable with zip tie. Do not crush cable.
  - 5. Install WAP.

### 3.4 OUTDOOR BUILDING MOUNTED INSTALLATION

- A. Building penetration and J-box provided by EC.
- B. Install/mount equipment securely according to manufacturer's instructions, applicable reference standards, and approved shop drawings.
  - 1. Leave any protective plugs and covers installed until immediately prior to completing associated installation or connection.
  - 2. Install mounting bracket with stainless steel wall anchors.
  - 3. Tip pigtails and/or provide coupler as necessary.
  - 4. Provide flexible conduit cut to length and feed cable through.
  - 5. Install weather-tight fittings for flexible conduit at J-box and WAP.
  - 6. Install WAP.
  - 7. Install stainless steel routing clamps as necessary to support conduit against wall.

### 3.5 FIELD QUALITY CONTROL

- A. Capture the photographs required by 1.5A.1 on the same day the installation is completed at each IDF.

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3.6 CLEANING

- A. Cleanliness: Remove dust and debris from the work area. Remove packaging. Deliver unused parts to NOC.

END OF SECTION

## SECTION 27 26 23 – NETWORK PROGRAMMING AND INTEGRATION REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes
  - 1. UPS configuration.
  - 2. Switch configuration.
  - 3. WAP configuration.
  - 4. System tests and adjustments.
- B. Related Requirements
  - 1. Section 27 05 00 Common Work Results for Communications
  - 2. Section 27 11 26 Communications Rack Mounted Power Protection and Power Strips
  - 3. Section 27 21 29 Data Communications Switches
  - 4. Section 27 21 33 Data Communications Wireless Access Points
- C. Narrative: The design intent of this section is to program the uninterruptible power supply, network switch, and wireless access point equipment installed under the other sections of this division, integrate them with the Owner's existing network infrastructure and management systems, test functionality and performance, and adjust to optimize performance. Testing is to include a preliminary, passive site survey of the indoor and outdoor areas covered by WAPs installed under section 27 21 33 to inform possible adjustments, and a final, as-built, combination passive/active site survey.

#### 1.2 REFERENCES

- A. Abbreviations and Acronyms
  - 1. BSSID: Basic Service Set Identifier
  - 2. dB: Decibels
  - 3. dBm: Decibels power relative to 1 mW
  - 4. Cat: Category (cable)
  - 5. CCTV: Closed-Circuit Television
  - 6. CW: Channel Width
  - 7. (E): Existing
  - 8. EC: Electrical Contractor
  - 9. ESSID: Extended Service Set Identifier
  - 10. IDF: Intermediate Distribution Frame
  - 11. IP: Internet Protocol
  - 12. LAN: Local Area Network
  - 13. LR: Long Reach
  - 14. PDU: Power Distribution Unit
  - 15. PLR: Packet Loss Ratio
  - 16. PoE: Power-over-Ethernet

17. RF: Radio Frequency
18. RTT: Round-trip time
19. SR: Short Reach
20. STP: Shielded Twisted Pair
21. UPS: Uninterruptible Power Supply
22. UTP: Unshielded Twisted Pair
23. VLAN: Virtual LAN
24. VoIP: Voice-over-IP
25. WLC: Wireless LAN Controller
26. WAP: Wireless Access Point

B. Definitions

1. Throughput: Successful data transfer rate in b/s, averaged over a defined measurement time interval, from sender to receiver, inclusive of network layer (IP) and data link layer (Ethernet) protocol encapsulation headers.

C. Reference Standards

1. OSHA Standards - 29 CFR Sections 1910 and 1926
2. ANSI/BICSI 001-2017 R22 Information and Communication Technology Systems Design and Implementation Best Practices for Educational Institutions and Facilities
3. ANSI/BICSI 008-2018 Wireless Local Area Network (WLAN) Systems Design and Implementation Best Practices
4. IEEE Std 802.1x-2020
5. IEEE Std 802.3-2022
6. IEEE Std 802.11-2020
7. IEEE Std 802.11ax-2021

### 1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Coordinate configuration parameters with Owner.
  - a. Firmware and software version and patch levels.
  - b. Licensing.
  - c. Configuration templates and/or sample configuration(s) from comparable existing equipment.
  - d. IP address plan structure and address assignments.
  - e. VLAN ID assignments and identification.
  - f. Host name identification.
  - g. ESSID(s).
  - h. Short-term credentials as needed to administer applicable network management system for the purposes of performing work under this section.
  - i. Long-term credentials as applicable to each device or component:
    - 1) RADIUS secrets.
    - 2) SNMP community strings, authentication, and/or encryption secrets.
    - 3) Certificates.
    - 4) Machine accounts for centralized authentication systems.
    - 5) Local administrator accounts.

2. Schedule active network testing to avoid interference with normal network activities, both to avoid causing disruption and to ensure test results reflect true performance potential.
  3. Contractor to furnish and operate for the duration of the contract a method and supporting systems as necessary to facilitate the secure exchange of data among Contractor, Owner, and Engineer. Email is considered insecure unless augmented by a security layer such as S/MIME, OpenPGP, or file encryption format that uses symmetric cryptography having exchanged key material via a secure channel. The use of bearer URLs without an additional, individual authentication factor is considered insecure.
- B. Pre-implementation Meetings: Arrange pre-implementation meeting at least 1 week prior to commencing work with all parties associated with trade or as requested by Engineer. Presided over by Contractor, include Engineer who may attend, Subcontractor performing work of this trade, Owner's representative.
- C. Sequencing
1. Commence programming and integration of the switches installed under section 27 21 29 as soon as practical to provide sufficient network connectivity for other work performed under this division, and for other, network-adjacent trades such as the security system installer.
  2. Contractor is responsible for all other sequencing and scheduling.

#### 1.4 ACTION SUBMITTALS

- A. Test and Evaluation Reports:
1. RF Passive Site Survey:
    - a. Report contents:
      - 1) Indoor and outdoor heat maps referenced to the wireless survey background drawings attached to this section as Appendix 1.
      - 2) Raw measurement data in a non-proprietary machine-readable format.
    - b. Minimum reportable BSSID signal level, whether installed under section 27 21 33 or not: -92 dBm.
    - c. Measurement bands:
      - 1) 2.4 GHz.
      - 2) 5 GHz.
      - 3) 6 GHz
    - d. Measurements by BSSID:
      - 1) Signal level in dBm.
      - 2) Signal-to-noise ratio in dB.
      - 3) Signal-to-interference ratio in dB.
    - e. Coverage requirements:
      - 1) Sample density: every 3–5 ft indoors; every 5–15 ft outdoors.
      - 2) Indoor: For each room/space in which a WAP is installed, walk the perimeter, 3–5 ft from the nearest wall, and cross through the center of the room between diagonally opposite corners.
      - 3) Outdoor:
        - a) Sidewalk and curb areas adjacent to the bus pick-up/drop-off area, from the northeast corner of the gymnasium to the northeast corner of the east wing of the building: walk the sidewalk, end to end.



- b) Sidewalk and curb areas adjacent to the car pick-up/drop-off area, from the southwest corner of the building to the southeast corner of the building: walk the sidewalk, end to end.
- 2. Active Site Survey:
  - a. Active functional and performance measurements are to be performed between a test set in the field and a test set connected to the TESD core switches at the NOC.
  - b. RTT with 1 ms or less resolution for each of 20 probes at 1 s intervals. Include minimum, maximum, mean, and standard deviation summaries.
  - c. Bi-directional data transfer of at least 1 GB. Measurements at 1 s resolution or better.
    - 1) PLR.
    - 2) Re-transmission count.
    - 3) Throughput in b/s.
  - d. Additional requirements for wired measurements
    - 1) Baseline results of each of the above measurements when test sets are connected directly to each other.
    - 2) Report switch port identification, configuration, and operational state details as of the start of the test.
  - e. Additional requirements for wireless measurements:
    - 1) PHY rate.
    - 2) Proof of successful association and authentication on each ESSID and RF band being broadcast.
    - 3) Report BSSID.
    - 4) Report physical location of test set such that it is reproducible within  $\pm 3$  ft for indoor WAPs and within  $\pm 10$  ft for outdoor WAPs.

## PART 2 - PRODUCTS

### 2.1 NETWORK CONTROL AND MANAGEMENT SYSTEMS

- A. (E) Schneider Electric EcoStruxture IT
- B. (E) Aruba 7210 Wireless Mobility Controller
- C. (E) Aruba AirWave
- D. (E) WhatsUp Gold

### 2.2 EQUIPMENT

- A. All equipment, optical transceivers, patch cables, and software necessary for testing is the responsibility of the Contractor and is to be removed after successful completion of all testing.
- B. Wireless Test Equipment:
  - 1. Wi-Fi RF Bands: 2.4 GHz, 5 GHz, and 6 GHz
  - 2. Wi-Fi Standard(s): 802.11n/ac/ax/be
  - 3. Receiver Sensitivity:  $-92$  dBm

4. Additional requirements for active measurements:
    - a. Must be capable of sourcing and sinking traffic at 95% or greater of max PHY rate.
    - b. 2x2 spatial streams.
  5. Furnish and operate a test set for passive and active site surveys.
- C. Wired Test Equipment:
1. Connection types:
    - a. 1/2.5/5/10 Gb/s Cat 6A copper Ethernet.
    - b. 10 Gb/s SFP+ fiber-optic transceivers or DAC cable compatible with switches installed under section 27 21 29.
    - c. 10 Gb/s SFP+ fiber-optic transceiver to connect to existing Juniper EX-series switches at the NOC. Existing 10 Gb/s ports, available to accept test set connections, are unused connectors on break-out cables connected to existing SR and LR transceivers.
  2. Must be capable of sourcing and sinking traffic at 95% or greater of connected line rate.
  3. Furnish and operate a test set in the NOC to support both wired and wireless active site surveys at the site.
  4. Furnish and operate a test set to perform wired active site survey.

### PART 3 - EXECUTION

#### 3.1 IMPLEMENTATION

- A. Adjust Firmware Version:
1. If elected by Owner, upgrade to the latest available security patch level of the latest, fully-manufacturer-supported firmware version.
  2. Otherwise, upgrade or downgrade equipment firmware version to match that of equivalent existing equipment.
- B. Install minimal configuration sufficient for connection to existing network and enrollment in existing centralized management systems.
- C. Enroll equipment in centralized management where applicable.
1. Integrate UPS equipment with Schneider Electric EcoStruxure IT.
  2. Integrate switches with Aruba AirWave and WhatsUp Gold.
  3. Integrate WAPs with Aruba Mobility Controller and Aruba AirWave.
- D. Deploy full, detailed configuration.

#### 3.2 FIELD QUALITY CONTROL

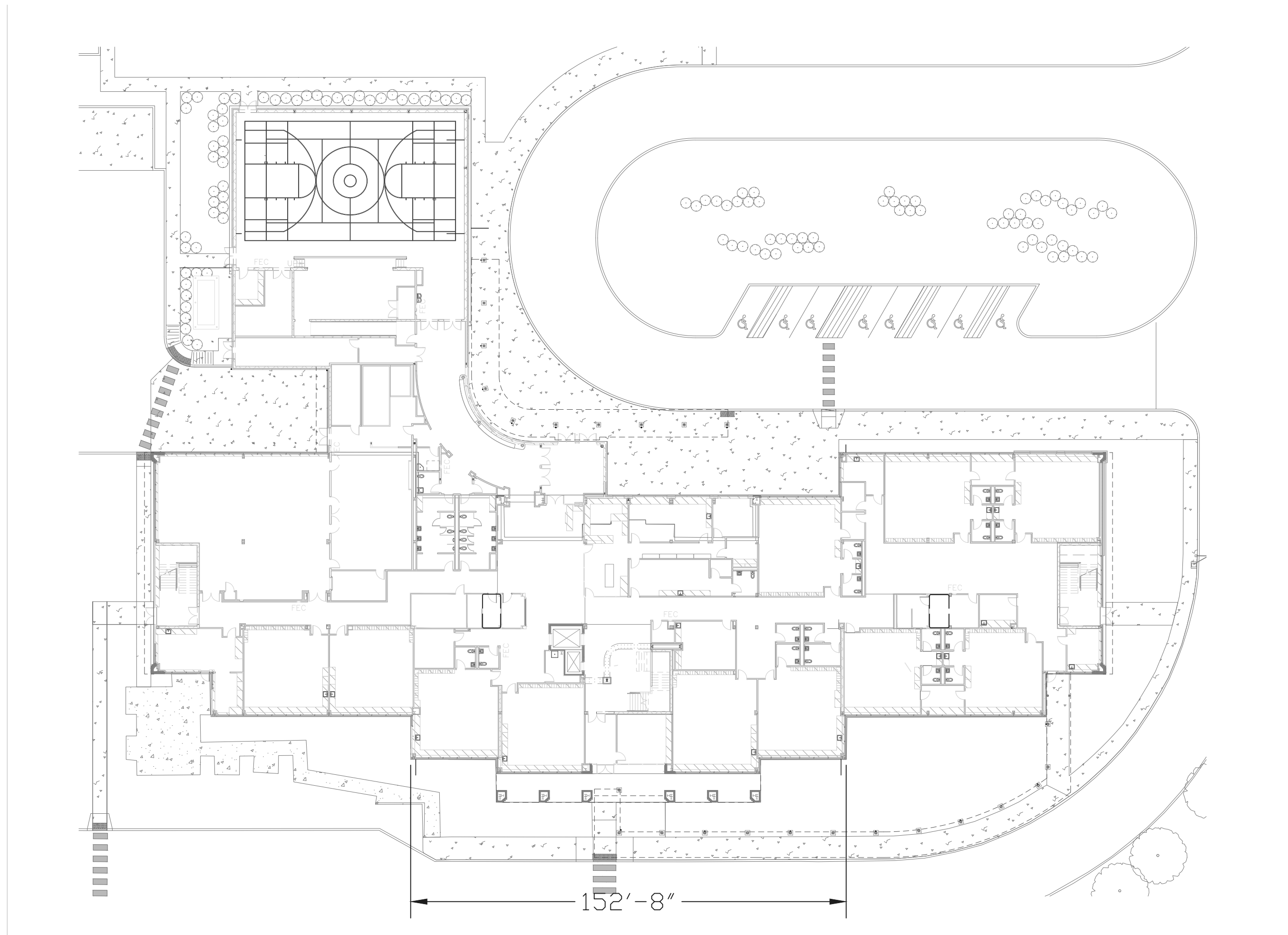
- A. Initial Acceptance Testing:
1. For each switch, from a workstation connected at the NOC:
    - a. Ping the management interface.
    - b. SSH to the management interface and authenticate to the highest available level.

- c. Verify that basic status/health indication is OK (green) in Aruba AirWave and WhatsUp Gold.
  2. For each UPS:
    - a. Ping the management interface.
    - b. Verify that basic status/health indication is OK (green) in Schneider Electric EcoStruxure IT, and that system load (W) and input (V) are being remotely measured.
  3. For each WAP:
    - a. Verify that basic status/health indication is OK (green) in Aruba AirWave.
    - b. Verify that the WAP uplink has auto-negotiated to a >1 Gb/s line speed.
- B. Passive Site Survey
  1. After successful completion of initial acceptance testing, perform a preliminary passive site survey and submit results in accordance with 1.4A.1.
  2. After adjustments to WAP channel and RF power settings, and subsequent, successful completion of Active Site Survey, perform a final, as-built passive site survey and submit results in accordance with 1.4A.1. Coverage requirements may only be waived or relaxed if there have been no adjustments nor configuration changes to the equipment in the area subject to survey and only with the approval of the Engineer.
- C. Active Site Survey
  1. Perform active site surveys after adjustments to WAP equipment per section 27 21 33.
  2. Corrective action:
    - a. If a test fails to achieve threshold performance, investigate to determine the proximate cause.
    - b. If the cause lies with equipment or software installed or programmed under this division, revise the faulty programming and/or repair/replace the faulty equipment and repeat programming.
    - c. If the cause lies with existing equipment or software, permit TESD IT Staff and Engineer an opportunity to take corrective action through reprogramming, repair, and/or replacement of implicated components.
  3. Re-testing:
    - a. For all equipment or software installed and/or programmed under this division, repeat tests at no added cost to Owner until all tests achieve threshold performance.
    - b. For all other components, repeat each test at least once at the request of TESD IT staff or Engineer following corrective action in response to the failure of that test.
  4. Wired:
    - a. Measurements and submittal: In accordance with 1.4A.2.
    - b. Coverage requirements:
      - 1) Any (1) access port selected at random on each physical switch installed under section 27 21 29.
    - c. Threshold performance:
      - 1) RTT: maximum < 5 ms; mean < 3 ms
      - 2) PLR: < 0.5%
      - 3) Throughput for each negotiated line speed applicable to the port capabilities:
        - a) 1 Gb/s line speed:  $\geq 900$  Mb/s
        - b) 2.5 Gb/s line speed:  $\geq 2200$  Mb/s
        - c) 5 Gb/s line speed:  $\geq 4250$  Mb/s
        - d) 10 Gb/s line speed:  $\geq 8000$  Mb/s

Wireless:

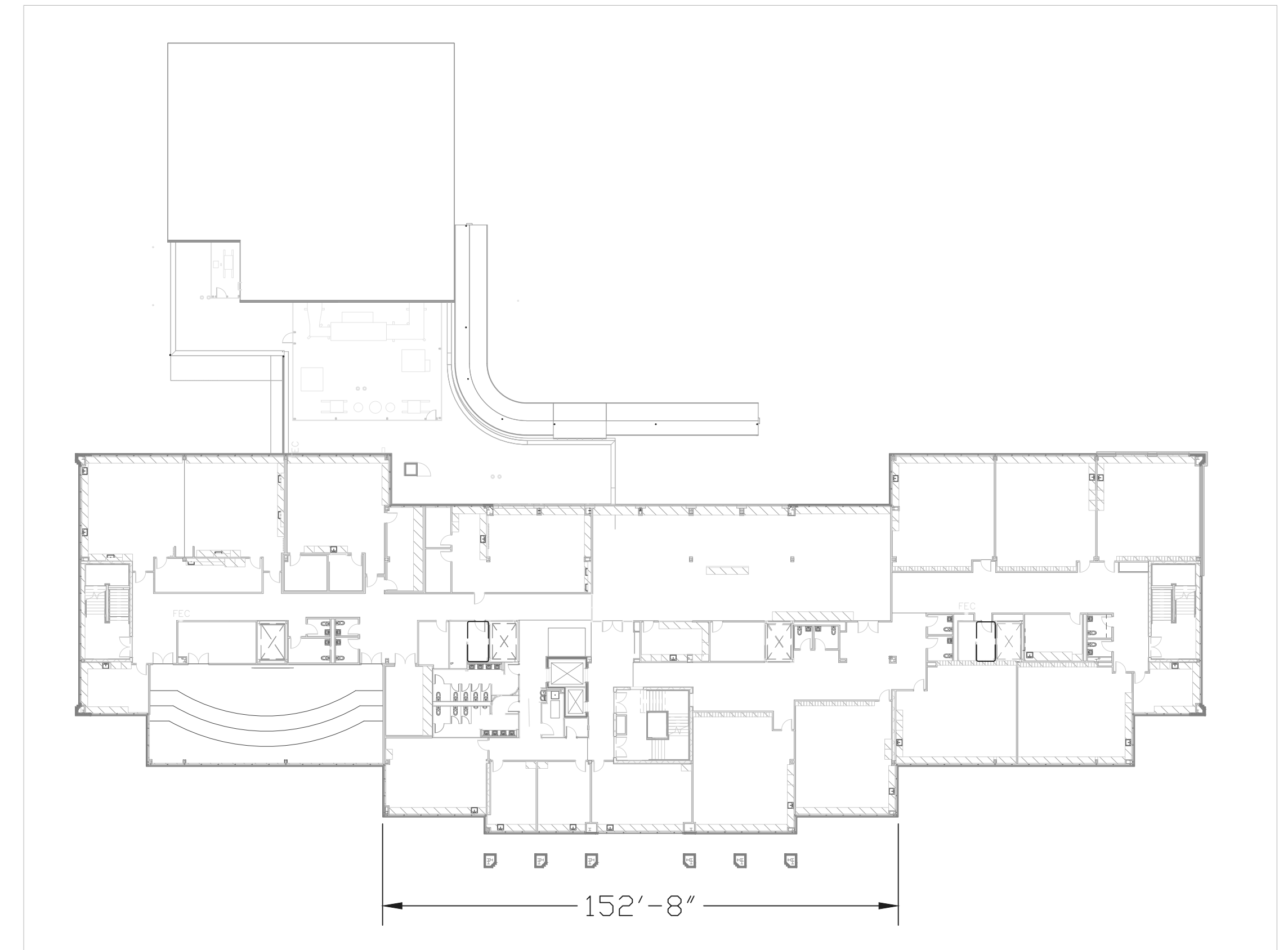
- d. Measurements and submittal: In accordance with 1.4A.2.
- e. Coverage requirements:
  - 1) Any (4) indoor WAPs selected at random. Test set to be located at a straight-line distance to the WAP of no less than 10 ft, or the highest distance permitted by the dimensions of the room/space, whichever is shorter.
  - 2) Any (2) outdoor WAPs selected at random. Test set to be located at a straight-line distance of no less than 20 ft to the WAP.
- f. Threshold performance:
  - 1) RTT: maximum < 6 ms; mean < 4 ms
  - 2) PLR: < 1.0%
  - 3) Throughput for each band broadcast by the WAP:
    - a) 2.4 GHz:  $\geq 340$  Mb/s
    - b) 5 GHz and 6 GHz, indoor:  $\geq 1440$  Mb/s
    - c) 5 GHz and 6 GHz, outdoor:  $\geq 690$  Mb/s

END OF SECTION



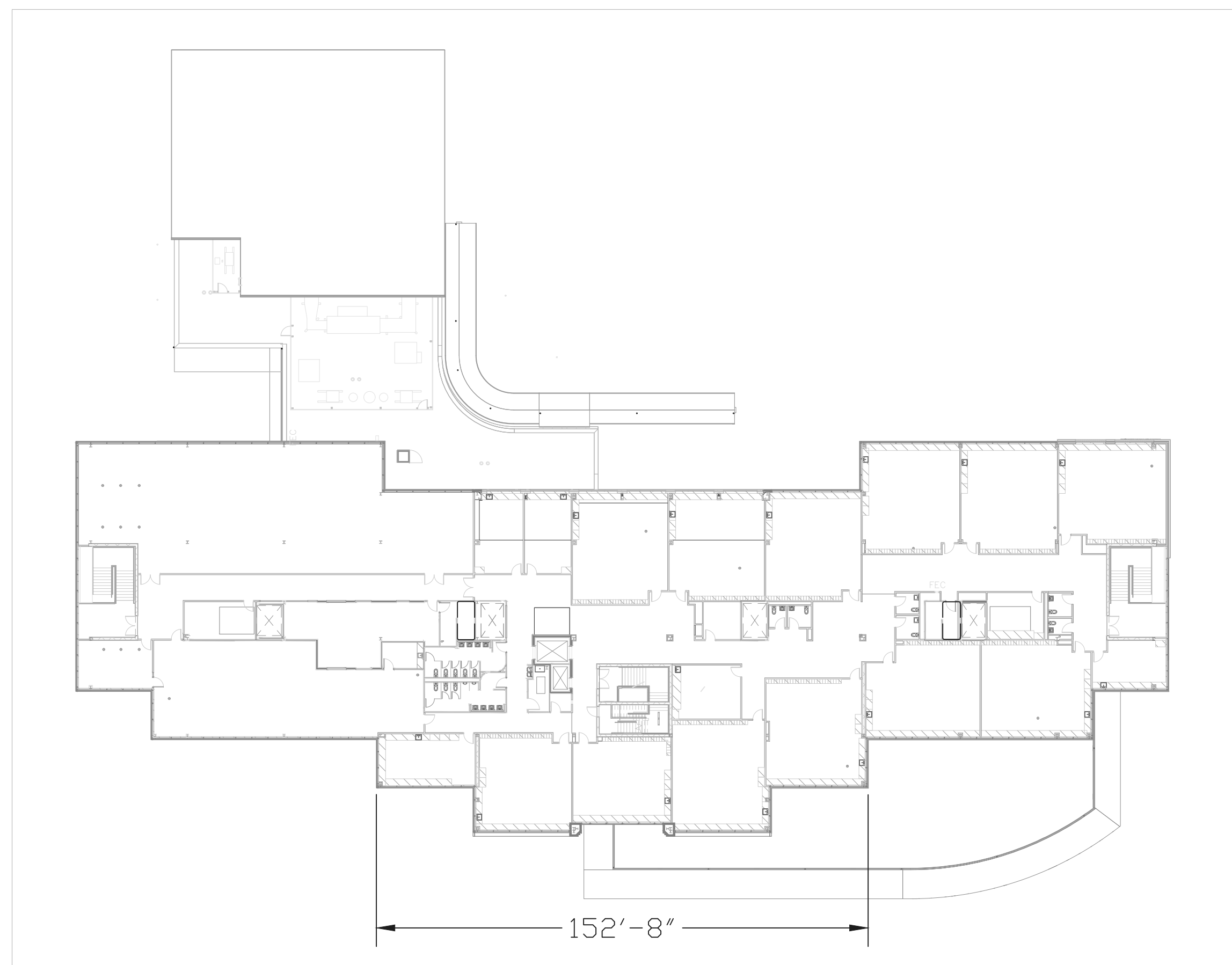
1 FIRST FLOOR PLAN

Scale: 1/32" = 1'



2 SECOND FLOOR PLAN

Scale: 1/32" = 1'



3 THIRD FLOOR PLAN

Scale: 1/32" = 1'

TREDYFFRIN/EASTTOWN SCHOOL DISTRICT  
1200 W. SWEDES FORD ROAD

HSA PROJECT #23-037

27 26 23 NETWORK PROGRAMMING AND  
INTEGRATION REQUIREMENTS

APPENDIX 1 WIRELESS SURVEY BACKGROUNDS

2024-03-28 BID ISSUE

SECTION 275133 – INTEGRATED ELECTRONIC COMMUNICATIONS NETWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. The contractor shall furnish and install all equipment, accessories, and materials in accordance with these specifications and drawings to provide a complete and operating VoIP school communications system. This specification is based on the Bogen Nyquist E7000 school communications platform which is considered the Tredyffrin-Easttown School District standard.
- B. The comprehensive school communications system shall provide all-call and zone paging, loudspeaking two-way intercom, class change-tones, and music program distribution. VOIP Station Modules shall be employed in the MDF (*Rack Location*) as well as in IDFs throughout the building to support analog speakers. A combination of Network UTP, UTP, and STP cables shall be utilized to support all system devices. See the following link for mandatory system features:

<https://www.bogen.com/sites/default/files/2024-06/Bogen%20E7000%20System%20Features.pdf>

1.2 REFERENCES

- A. ANSI/NFPA 70 – National Electrical Code
- B. ANSI/NEMA SB-40 – Emergency Communications Systems for Life Safety in Schools.
- C. UL 60950 – Information Technology Equipment - Safety

1.3 SUBMITTALS FOR REVIEW

- A. Shop Drawings: The following items shall be submitted for review and approval:
  - 1. Submittal booklet to include the following:
    - a. Reference to Specification Section.
    - b. A list of all equipment to be provided and installed in the system.
    - c. Data sheets of all items to be provided with specific item or model number highlighted.
    - d. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring. Identify terminals to facilitate installation, operation, and maintenance. Include a single-line diagram showing cabling interconnection of components and levels throughout system and impedances. Delineate contractor furnished and owner furnished network equipment.
    - e. Each drawing shall have a descriptive title and all sub-parts of each drawing shall be labeled. All drawings shall have the name and locations of the project, Systems Contractor's name in the title block. Provide drawings showing all equipment required by these specifications for this project.
    - f. Details and descriptions of any other aspect of the system, which must differ from the contract documents due to field conditions or equipment, furnished.
- B. FCC Approval: The system shall be approved for direct interconnection to the telephone utility under Part 68 of FCC rules and regulations. Provide the FCC registration number of the system being proposed as part of the submittal process.

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- C. Product Certificates: Signed by manufacturers of equipment certifying that products furnished comply with specified requirements.
- D. Installer Certificates: Signed by manufacturer certifying that installers comply with requirements.
- E. Manufacturer Certificates: Signed by manufacturers certifying that they comply with requirements.
- F. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Include record of final matching transformer-tap settings, and signal ground-resistance measurement certified by Installer.
- G. Maintenance Data: For equipment to be included in maintenance manuals specified in Division 1.
  - 1. Record of Owners equipment-programming option decisions.
  - 2. All instructions necessary for proper operation and manufacturer's instructions.
  - 3. "Proof of Performance" information.
  - 4. Manufacturer's maintenance information.
  - 5. Copies of non-proprietary computer programs and system set up disks documenting all programmable features of the installed system.
- H. System Training: Submit the following information describing the training programs and system trainers as outlined in paragraph 1.6 of this specification and in accordance with Division 1 specifications.
  - 1. Include with the submittal a preliminary staff development training program in outline form for review and approval by the owner's representative.
  - 2. Include with the submittal a current copy of the trainer's certification from the manufacturer that certifies and identifies the trainer(s) who are eligible to provide training and support for the project.
  - 3. Include with the submittal a current copy of trainer's need's assessment form which will be reviewed with the Owner's designated representative for the system's preliminary system programming and configuration.
  - 4. Include with the submittal copies of all documentation used to identify for the owner those participants attending and completing the training programs.

#### 1.4 SUBMITTALS FOR CLOSEOUT

- A. Drawings of the completed system reflecting any changes that were made from the original submission of drawings.
- B. A letter from the installing sub-contractor stating that all equipment provided is covered by the required warranty.
- C. Training Completion sign in form.

#### 1.5 QUALITY ASSURANCE

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by UL or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.
- C. Installer Qualifications: An experienced installer who is an authorized representative of equipment manufacturer for both installation and maintenance of equipment required for this Section. The installer's

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main service location must be within a 2-hour travel time from the project site. Provide the following with in thirty (30) days after notification to proceed:

1. Provide a list of installations of systems meeting the specifications herein that the Installer has specifically installed for verification by the Owner. Provide contact name, phone number and email address for all installation sites. Random installations from other vendors and/or Installers shall not be accepted. The Installer, not its employees, must meet these qualifications.
  2. The Installer shall demonstrate to the satisfaction of the Owner or his representative that he has:
    - a. Adequate plant and equipment to pursue the work properly and expeditiously.
    - b. Adequate staff and technical experience to implement the work.
    - c. Suitable financial status to meet the obligations of the work.
    - d. Technically capable and factory trained service personnel at a local service facility to provide routine and emergency service for all products used in this project.
  3. Installer shall employ a fulltime staff for installation, maintenance, and client support.
  4. Submittal shall include copies of reference site contacts and manufacturer and staff technical certifications.
- D. Any Contractor, who intends to bid on this work and does not meet the requirements of the “Quality Assurance” paragraph(s), shall employ the services of an “Installer” who does meet the requirements and who shall provide the equipment, perform terminations, and continuously supervise the installation. A subcontractor so employed as the “Installer” must be acceptable to the Architect/ Engineer. The “Installer” shall be identified within thirty (30) days of notification to proceed for acceptance by the Architect/Engineer
- E. Because the life expectancy of this type of communications structure normally exceeds 10 years, the owner expects continuity from the service provider. The installing/servicing company shall be an authorized provider of the manufacturer’s product or similar product for at least 15 years.
- F. Each major component of equipment shall have the manufacturer’s name and model number, NEMA code ratings, UL Label, and other data factory printed on the surface of the equipment and easily visible.
- G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- 1.6 IN-SERVICE TRAINING
- A. The contractor shall provide and implement a complete and comprehensive staff training program for all administrators, facility staff members, and teachers. This mandatory training program will provide school staff a complete understanding of how to utilize and properly operate all functions.
  - B. The training program shall be implemented by a staff member/trainer employed by the contractor. The trainer must be factory certified to provide training on their product.
  - C. All staff development training is to be coordinated through the Owner’s designated representative. As training sessions are completed, the trainer will provide the school’s administrative staff and school district’s staff a document listing all the staff and faculty members who attended, received, and completed the training program.
- 1.7 SINGLE SOURCE RESPONSIBILITY
- A. Except where specifically noted otherwise, all equipment supplied shall be the standard product of a single manufacturer of known reputation and a minimum of 30 years of experience in the industry. The



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supplying contractor shall have attended the manufacturer's installation and service training classes. A certificate of this training shall be provided with the contractor's submittal.

1.8 PROTECTION

- A. The contractor shall provide all necessary transient protection on the AC power feed and on all station lines leaving or entering the building.
- B. The contractor shall note on their system drawings, the type and location of these protection devices and all wiring information. Such devices are not to be installed above the ceiling.

1.9 WARRANTY

- A. Provide a manufacturer's five-year warranty of the school communications network equipment against defects in material and workmanship. This warranty will cover all central electronic equipment as well as peripheral devices such as speakers, horns, microphones, and administrative telephones. If any defects are found within the warranty period, the defective equipment shall be replaced at no cost (equipment only); a one-year warranty shall be provided for labor.
- B. A copy of the manufacturer's standard statement of warranty proving all equipment provided for the school communications network is covered with the required five-year warranty shall be included with the project submittal. This statement of warranty shall be provided on the manufacturer's letterhead. The standard five-year warranty is an important element in establishing a standard in quality. Manufacturers who circumvent the five-year warranty by offering special "extended warranties" that are not part of their normal published warranty will not be accepted.
- C. The manufacturer's warranty shall include software updates including full version software releases and service patches for the full five years.
- D. Contractor shall respond, excluding weekends and holidays, within 24 hours to any warranty service calls. If equipment cannot be repaired within 24 hours of service visit, the contractor shall provide "loaner" equipment to the facility at no charge.
- E. Make available a service contract offering continuing factory authorized service of the system after the initial warranty period.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage and are identified with labels describing contents.
  - 1. NQ-E7030 Analog Station Bridge: Qty 1
  - 2. Ceiling and Wall-Mounted Speakers: Qty 2 of each type and rating installed.
  - 3. Horn Speaker: Qty 1 of each type and rating installed.
  - 4. Volume Control: Qty 2

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Bogen Nyquist E7000MCR System manufactured by Bogen Communications LLC

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1. District Standard Product. No Substitutions.

- B. Authorized Bogen Distributor and current District Vendor:  
Intellicom Systems Inc.  
7112 Airport Highway  
Pennsauken, New Jersey 08109  
Contact: Mike Ramano  
Phone: 856-665-5366 Ext. 320  
Email: [romanom@intellcomsys.com](mailto:romanom@intellcomsys.com)

## 2.2 EQUIPMENT

- A. Bogen Nyquist NQ-E7000MCR Factory Assembled Rack Assembly consisting of:
1. 42" Free-Standing Rack with Locking Rear Door, Locking PC Drawer, Casters
  2. 1500VA UPS with Surge Protection
  3. NQ-SYSCTRL Nyquist System Controller
  4. Nyquist Software and Licensing Package
  5. Mini Administration PC
  6. NQ-E7010 Input/Output Controller
  7. NQ-P0100 Matrix Mixer/Preamplifier
  8. Bluetooth Receiver with External Antenna
  9. NQ-16P-POE+ 16-Port POE Switch
  10. NQ-E7030 24-Port Analog Station Module{s}
  11. NQ-A4060-G2 4-Channel 60-Watt Power Amplifier
  12. NQ-TEL-SIP District Telephone System Interface Software
- B. Bogen Nyquist Peripheral Equipment in quantities required by project plans:
1. NQ-E7030 24-Port Analog Station Module{s} (*located in IDF's*)
  2. NQ-T1100 VoIP Color Touchscreen Phone (*Main Office*)
  3. NQ-T2000 VoIP LCD Phone (*Greeter Station*)
  4. DDU250/NQ-GA10P Emergency Paging Microphone (*Location TBD*)
  5. ACT Ceiling Mount Speakers: CSD2X2U-V2 2x2 Ceiling Tile Speaker
  6. Combination Clock Speaker: Quam C5/BU/CK1/S Clock/Loudspeaker Baffle with ES8-CK Recessed Backbox. Mount horizontally.
  7. Wall Mount Speaker: MB8TSL Surface Wall Speaker
  8. Exterior Wall Mount Speaker: Quam System 36VPS Surface Vandal-Resistant Exterior Speaker
  9. Astatic 631L Noise Canceling Microphone with Viking VE-9-x12-0P Enclosure with VE-PBL Push Button Lock
  10. AT10A Single-Gang Volume Control

## 2.3 SYSTEM WIRING

- A. Manufacturers
1. Commscope
  2. Belden
  3. West Penn
- B. Wiring type and gauge shall be as recommended by the system manufacturer.
- C. All wiring shall be plenum rated.

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- D. The minimum cable size to classrooms/SGR shall be 22/2 stranded/shielded; to corridors, gang toilet rooms, outside horns and multiple loudspeaker areas shall be 18/2 stranded.
- E. 24-Port Analog Station Module to IDF: CAT6E

#### 2.4 ZONED PAGING

- A. The Paging system for this project shall be a zoned dial access paging system. The system shall be provided for the following Zones:
  - 1. All Page – inside and outside building.
  - 2. All Page – inside the building only.
  - 3. All Page – outside the building only.
  - 4. Exterior paging zones:
    - a. Playground areas.
  - 5. Interior paging zones as designated by Owner.
  - 6. Miscellaneous Zones (up to 32)
  - 7. The system shall be capable of delivering classroom change tones to the above zones on a programmable basis.
- B. All hallway and gang rest room speakers shall be run on a 25V daisy chain distribution style system, one chain per floor, maximum of 40W per individual homerun cable.
- C. Rooms with more than one speaker shall run on a 25V daisy chain distribution style system, back to the main paging rack.
- D. All other paging speakers shall be individually wired for 25V operation back to the main paging rack.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine conditions, with the Installer present, for compliance with requirements and other conditions which could affect the performance of the system.
- B. Do not proceed until unsatisfactory conditions have been corrected.

#### 3.2 INSTALLER/CONTRACTOR REQUIREMENTS

- A. All final headend, programming, and certification work shall be performed by a documented manufacturer's authorized representative.
- B. The manufacturer's representative shall have completed at least 10 projects of equal scope, giving satisfactory performance, and shall have been in the business of furnishing and installing sound systems of this type for at least five years. The manufacturer's representative shall be capable of being bonded to ensure the owner of performance and satisfactory service during the guarantee period.
- C. The manufacturer's representative shall provide a letter with submittals from the manufacturer of all major equipment stating that the manufacturer's representative is an authorized distributor. This letter shall also state that the manufacturer guarantees service performance for the life of the equipment and

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that there will always be an authorized distributor assigned to service the area in which the system has been installed.

- D. The contractor shall furnish a letter from the manufacturer of the equipment. This letter shall certify that the equipment has been installed according to factory intended practices, that all the components used in the system are compatible, and that all new portions of the systems are operating satisfactorily. Further, the contractor shall furnish a written unconditional guarantee for all parts and all labor for a period of five years after final acceptance of the project by the owner.

### 3.3 INSTALLATION

- A. Comply with installation instructions provided by system manufacturer.
- B. Provide wiring as required for a properly operating system.
- C. Impedance and Level Matching: Carefully match input and output impedances and signal levels at signal interfaces. Provide matching transformers where required.
- D. Control Circuit Wiring:
  - 1. Install control circuits in accordance with NFPA 70 and as indicated. Provide number of conductors as recommended by system manufacturer to provide control functions indicated or specified.
  - 2. Connect field cable to each Analog Speaker transformer using UL butt splices for #2wire. Any unused transformer leads shall be individually safed-off/insulated.
- E. Category 6E installation shall meet the requirements of Division 27.
- F. Wiring Methods:
  - 1. Wire Routing: Route all device wiring from each device up into ceiling cavity within metallic conduit in recessed or unfinished areas or within surface raceway for renovated non-fishable areas. Stub all conduits into ceiling cavity and provide protective bushing for each.
  - 2. Cable Routing: Route cable for all device wiring within accessible ceiling cavities. Install in bridle rings at 4' spacing maximum. No cabling is to lie on or attach to ceiling tile, ducts, pipes, conduits or ceiling suspension wires, rods, or structural members. Provide conduit stubs from devices and panels to the ceiling cavities.
  - 3. Route all system wiring from the equipment within metallic conduit up into nearby ceiling cavity and connect to the wiring system indicated above. Provide bushings at conduit ends.
  - 4. Provide raceways for cabling in all open structure spaces.
- G. Cable identification shall be provided on both ends of each cable and termination with the Owners room number and the wiring block or device to which it is connected. Tags shall be permanent and neat.
- H. Provide necessary conduit, raceways, pull boxes, outlet boxes and wire to provide a complete and operational system.
- I. All wiring shall be tested for continuity and freedom of all grounds and short circuits.
- J. Each cable run between the console and remote locations shall be one continuous cable. System cable shall not share conduit with any other system.
- K. Paint exterior speaker baffles in color selected by Architect.

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- L. The contractor shall provide necessary transient protection on the AC power feed, all copper station lines leaving or entering the building, and all central office trunks. All protection shall be as recommended by the equipment supplier and referenced to earth ground.
- M. Wiring within Enclosures: Provide adequate length of conductors. Bundle, lace, and train the conductors to terminal points with no excess. Provide and use lacing bars.
- N. Provide physical isolation from speaker-microphone, telephone, line-level wiring, and power wiring. Run in separate raceways, or where exposed or in same enclosure, provide 12" minimum separation between conductors to speaker-microphones, telephone wiring and adjacent parallel power. Provide physical separation as recommended by equipment manufacturer for other system conductors.
- O. Identification of Conductors and Cables: Use color coding of conductors and apply wire and cable marking tape to designate wires and cables so all media are identified in coordination with system wiring diagrams. Each cable identification shall have a unique number located approximately 1-1/2" from cable connection at both ends of cable. Numbers shall be approximately 1/4" in height. These unique numbers shall appear on the As-Built Drawings.
- P. Mark and label all demarks IDF and MDF points with destination point numbers. Rooms with more than one outlet shall be marked XXX-1, XXX-2, XXX-3, etc. where XXX is the room number.
- Q. No graphic room number shall exceed the sequence from 000001 through 899999.
  - 1. All outside speakers shall be on a separate Page Zone and Time Zone.
  - 2. District shall be provided with proposed zoning and station numbering lists before implementation into the system.
  - 3. Speaker transformers shall be wired/adjusted as indicated below unless otherwise indicated on point-to-point wiring plans.
  - 4. All zones shall be laid out not to exceed 40 Watts (@25V) maximum per zone.
  - 5. All hallway speakers shall be tapped at 1 Watt (@25V) maximum.
  - 6. All outside horns shall be tapped at 3.75 Watts (@25V) maximum.
  - 7. All classroom speakers shall be tapped at ½ Watt (@25V) maximum.
  - 8. Large rooms, such as cafeterias, shall be tapped at 2 Watts (@25V) maximum.
- R. Plug disconnect: All major equipment components shall be fully pluggable by means of multi-pin receptacles and matching plugs to provide for ease of maintenance and service.
- S. Protection of cables: Cables within terminal cabinets, equipment racks, etc., shall be grouped and bundled (harnessed) as to type and laced with No. 12 cord waxed linen lacing twine or T and B wire-ties, or hook and loop cable management. Edge protection material shall be installed on edges of holes, lips of ducts, or any other point where cables or harnesses cross a metallic edge.
- T. Shielding: Cable shielding shall be capable of being connected to common ground at point of lowest audio level and shall be free from ground at any other point. Cable shields shall be terminated in the same manner as conductors.
- U. Weatherproofing: Provide weatherproof enclosures for items to be mounted outdoors or exposed to weather.
- V. Volume Controls shall be wall-mounted:
  - 1. Mount at 48" AFF.
  - 2. All wiring should be concealed.
  - 3. Verify exact location with architect.

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- W. Administrative telephones shall be desk or wall mounted and have associated adjacent modular RJ45 jack.

### 3.4 GROUNDING

- A. Provide equipment grounding connections for Integrated Electronic Communications Network systems as required by manufacturer. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.
- B. Ground equipment, conductor, and cable shields to eliminate shock hazard and to minimize to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.
- C. Provide all necessary transient protection on the AC power feed and on all copper station lines leaving or entering the building. Note in system drawings, the type and location of these protection devices as well as all wiring information.

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide services of a duly factory authorized service representative for this project location to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.
- B. Inspection: Make observations to verify that units and controls are properly labeled, and interconnecting wires and terminals are identified. Provide a list of final tap settings of paging speaker line matching transformers.
- C. Testing: Rectify deficiencies indicated by tests and completely re-test work affected by such deficiencies at Contractor's expense. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

### 3.6 FINAL ACCEPTANCE TESTING

- A. The Final Acceptance Testing shall be provided to the Owner or the Owners designated representative only. Final acceptance testing to any other trade or service provider for the project will not comply with the requirements of this section.
- B. The contractor will provide a Final Acceptance Test record document signed by both the contractor and the Owner or designated Owner's Representative establishing the "In Warranty" date. The warranty period will not commence until the Final Acceptance Test is completed.
- C. Contractor shall be prepared to verify the performance of any portion of the installation by demonstration, listening and viewing test, and instrumented measurements. Make additional adjustments within the scope of work and which are deemed necessary by the Owner because of the acceptance test.
- D. Controller shall coordinate with District IT personnel for the SIP interface to the District telephone system.
- E. Verify the following prior to actual tests and adjustments to the systems:
  - 1. Electronic devices are properly grounded.

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2. Powered devices have AC power from the proper circuit and hot, neutral, and ground conductors are connected properly.
  3. Insulation and shrink tubing are present at each cable terminated on a terminal strip or connector without a shell.
  4. Dust, debris, solder splatter, etc. are removed.
  5. Cables are dressed, routed, and labeled correctly.
  6. Connections are consistent with regard to polarity.
- F. Audio System Tests: Measure and record the impedance of each loudspeaker terminating at the amplifier. An impedance meter must be used. A DC resistance meter will not be accepted. Record each speaker impedance measurement and provide to owner in “as-built” drawings.

### 3.7 OWNER TRAINING

- A. Contractor shall provide a minimum of eight hours of configuration and operational instruction to school personnel.
  1. Bogen Communications LLC, shall provide online “How To” videos for instructing the teaching staff on how to operate the Teacher Dashboard aspect of the system.
- B. Schedule training with Owner through the Owner’s representative, with at least seven days advance notice.

END OF SECTION 275133

SECTION 275313 – WIRELESS CLOCK SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide all equipment associated with the installation of the Clock System. This work shall include a master/transmitter, wireless secondary clocks and 120-volt wiring, and wireless repeaters as required for a complete and operating system. See the following link for mandatory system features:

<https://sapling-inc.com/wp-content/uploads/Sapling-Wireless-Clock-System-Brochure-V1.0.pdf>

1.2 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 260000.
- B. Shop Drawings: The following items shall be submitted for review and approval:
  - 1. Submittal booklet to include the following:
    - a. Reference to Specification Section.
    - b. A list of all equipment to be provided and installed in the system.
    - c. Data sheets of all items to be provided with specific item or model number highlighted.
    - d. Basic riser diagram to include all equipment and all wiring required.

1.3 SUBMITTALS FOR CLOSEOUT

- A. Record actual locations of master clock system and secondary clocks.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum 3 years documented experience and with service facilities within 100 miles of project.
- B. Installer: Company specializing in installing the products specified in this section with minimum three years documented experience.

1.5 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage and are identified with labels describing contents.
  - 1. Clocks: Furnish 2 of each type installed.

1.6 WARRANTY

- A. Provide the warranty specified in Section 260000.



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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Wireless clock system and components manufactured by Sapling Inc.  
1. District Standard Product. No Substitutions.

2.2 MASTER / TRANSMITTER

- A. The central control unit shall be comprised of an integrated master/Transmitter. It shall be microprocessor-based and user-programmable through its electronic keypad. The unit will permit programming, diagnostics, and activity logging via a network PC with valid login credentials. The unit will be fully interfaced to the Integrated Network Electronic Communication system listed in Section 275133. Provide all necessary ancillary equipment for the complete system operation.
- B. The system shall provide the following functions:
1. Capacity for storing 800 events and up to 100 holidays in non-volatile memory.
  2. Ability to review, edit and delete events.
  3. Review of events from any entered time of day.
  4. Events shall be programmable to any one or all zone circuits.
  5. Selection of any one of twenty-four (24) schedules to allow flexibility due to seasonal changes or special events.
  6. Fully automatic holiday program execution. Bells can be silenced, or special schedules can be implemented. Normal bells will resume after the holiday period.
  7. User-programmable Automatic Daylight Savings Time Change.
  8. Programmable Music-on-Class-Change, this feature shall be programmable from 1 to 15 minutes.
  9. Separate bell duration for each zone circuit.
  10. Latched operation of zones to control lighting or other devices.
  11. Ability to test all output zone circuits.
  12. Accumulation of down time during power outage to reset slave clocks, both minute-impulse and synchronous types after the power has been restored.
  13. User-programmable custom slave clock correction.
  14. Output relays rated at 5 amperes shall be provided on all four (4) zone circuits.
  15. Crystal-controlled time-base for assured accuracy.
  16. Lithium battery will provide not less than 5 years battery back-up for timekeeping function.
- C. Provide Sapling model SMA-3R0-1008-1 8-zone master clock with integrated wireless clock signal transmitter.
- D. Provide Sapling model SMA-1SM-0000-1 network repeater(s) for the building as required.

2.3 WIRELESS ANALOG SECONDARY CLOCKS

- A. The following equipment shall be furnished and installed in all locations and quantities as shown on the plans:
1. 12" Secondary Clocks shall be Sapling Model SAL-4BS-12R-14 wireless analog, 120V powered.
  2. 16" Secondary Clocks shall be Sapling Model SAL-4BS-16R-14 wireless analog, 120V powered.
  3. All clocks shall be 12" unless 16" is indicated on the plans.
  4. Provide wireguards for gymnasiums or where shown on the plans.

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with installation instructions provided by system manufacturer.
- B. Provide wiring as required for the system.
- C. Wiring Methods:
  - 1. Wire Routing: Route all device wiring from each device up into ceiling cavity within metallic conduit in recessed or unfinished areas or within surface raceway for renovated non-fishable areas. Stub all conduits into ceiling cavity and provide protective bushing for each.
  - 2. Cable Routing: Route cable for all device wiring within accessible ceiling cavities. Install in bridle rings at 4' spacing maximum. No cabling is to lie on or attach to ceiling tile, ducts, pipes, conduits or ceiling suspension wires, rods, or structural members. Provide conduit stubs from devices and panels to the ceiling cavities.
  - 3. Route all system wiring from equipment within metallic conduit up into nearby ceiling cavity and connect to the wiring system indicated above. Provide bushings at conduit ends.
  - 4. Provide raceways for cabling in all open structure spaces.
- D. Provide 2#12 + 1#12 ground in 3/4" conduit from secondary 120V clock to nearest 120V emergency receptacle circuit unless otherwise noted.

3.2 DEMONSTRATION

- A. Perform demonstration at final system inspection by qualified representative of manufacturer.
- B. Conduct walking tour of project and briefly describe function, operation, and maintenance of each component.

3.3 TRAINING

- A. Personnel Training: Provide and pay for the services of a factory-authorized service representative to demonstrate the system and train Owner's personnel.
  - 1. Provide training for operating, testing, troubleshooting and general maintenance of the system.
  - 2. Provide a 1-hour session to demonstrate the system.
  - 3. Provide documentation of sessions to Architect/Engineer with signatures of at least 3 Owners Representatives present at demonstration.

END OF SECTION 275313

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SECTION 283111 – COMBINATION FIRE ALARM MASS NOTIFICATION SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.
- B. Requirements specified in all other sections of Division 26 apply to this Section.

1.2 SUMMARY

- A. This Section covers fire alarm systems, including initiating devices, notification appliances, controls, and supervisory devices.
- B. Work covered by this section includes the furnishing of labor, equipment, and materials for installation of the fire alarm system as indicated on the drawings and specifications.
- C. The Fire Detection and Alarm System shall consist of all necessary hardware equipment and software programming to perform the following functions:
  - 1. Fire alarm and detection operations and other equipment as indicated in the drawings and specifications.
- D. General Scope:
  - 1. Install new main fire alarm panel, with new IP DACT with cellular backup. Connect fire alarm panel to existing 120V normal/emergency power.
  - 2. New NAC panels with new SLC loop. Connect NAC panels to 120V normal/emergency power.
  - 3. Provide new audio amplifier panel located near FACP. Provide and install new 120V normal/emergency power.
  - 4. Provide new annunciators with microphone.
  - 5. All duct detectors shall be provided with a RTS.
  - 6. New notification and audio devices appliances.
  - 7. Provide initiation devices.
  - 8. Provide and install wireguards on all devices located in the gym - initiation and notification devices.
  - 9. Provide protective lexan covers for all pull stations.
  - 10. Provide new door hold-open magnetic devices and connect into the fire alarm system for release.
  - 11. Provide new addressable monitoring and control modules for tamper switches, flow switches, elevators, smoke dampers and door hold open release.
  - 12. Field labeling: Each initiation and notification device shall have a clear, self-adhesive label applied that contains minimum 10 pt black lettering indicating the SLC or NAC panel loop

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number and address or number of the device.

13. A final fire alarm shop drawing as-built will be required at the completion of construction. This as-built must show all devices, their address (NAC or SLC) and the wiring configuration; wiring configuration means to show the notification and initiation wiring sequence from device to device, not the actual wiring location in the building. The goal is to have an accurate shop drawing showing how the fire alarm system is physically wired in the building.
14. Duct detector shut down shall be on a local level, not a global point.

### 1.3 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: The equipment and service described in this specification are those supplied and supported by Simplex, as provided by locally by Johnson Controls only, Sam Stanitski – 302 419 5605 – [samuel.stanitski@jci.com](mailto:samuel.stanitski@jci.com).
- B. Alternate Manufacturers:
  1. Notifier by Honeywell.
- C. The Manufacturer shall be a nationally recognized company specializing in fire alarm and detection systems. This organization shall employ factory trained and certified technicians, and shall maintain a service organization within 100 miles of this project location. The Manufacturer and service organization shall have a minimum of 10 years experience in the fire protective signaling systems industry.
- D. Fire Alarm System Supplier Certification, NICET Certification: The Fire Alarm System Equipment Supplier shall employ at least one individual full time in the office supporting this project that has attained NICET Level III Certification in Fire Alarm Systems. All submittals and drawings shall be approved, initialed and show the NICET Certification Number of the individual maintaining the certification and taking responsibility for the documentation. Otherwise, Submittals and Drawings must be stamped by a Registered Fire Protection Engineer.  
  
U.L. Certification: The Fire Alarm System Equipment Supplier shall be U.L. listed as an Alarm Service Company for Local, Remote, Auxiliary and Proprietary Protective Signaling Systems. The U.L. Listing Certification number for the Alarm Service Company shall be included in the submittal information.

### 1.4 CODES

- A. The system and all associated operations shall be in accordance with the following:
  1. Guidelines of the following Building Code: IBC 2018.
  2. NFPA 72, National Fire Alarm Code, referenced edition
  3. NFPA 70, National Electrical Code 2017
  4. NFPA 101, Life Safety Code
  5. NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems
  6. Other applicable NFPA standards
  7. Local Jurisdictional Adopted Codes and Standards

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8. ADA Accessibility Guidelines

1.5 SYSTEM DESCRIPTION

- A. General: Provide a complete, non-coded, addressable, microprocessor-based voice evacuation style fire alarm system with initiating devices, notification appliances, and monitoring and control devices as indicated on the drawings and as specified herein.
- B. Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary. The system shall be capable of 100% on-site programming to accommodate system expansion and facilitate changes in operation. All programming shall be capable of being accomplished via the front panel and via a laptop computer. All software operations shall be stored in a non-volatile programmable memory within the FACP. Loss of primary and secondary power shall not erase the instructions stored in memory.
- C. History Logs: The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. Separate alarm, supervisory and trouble logs shall be provided.
- D. Wiring/Signal Transmission:
  - 1. Transmission shall be addressable signal transmission, dedicated to fire alarm service only.
  - 2. System connections for initiating (signaling) circuits and notification appliance circuits shall be Class B.
  - 3. Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACP. Provide a distinctive indicating audible tone and alphanumeric annunciation.
- E. Remote Access:
  - 1. A personal computer or technician's laptop, configured with terminal emulation software shall have the ability to access the FACP for diagnostics, maintenance reporting and information gathering.
- F. Required Functions: The following are required system functions and operating features:
  - 1. Priority of Signals: Alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Supervisory and Trouble events have second-, and third-level priority respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all events regardless of priority or order received.
  - 2. Noninterfering: The activation of an addressable device does not prevent the receipt of signals from subsequent activations.
  - 3. Transmission to Remote Central Station: Automatically route alarm, supervisory, and trouble signals to a remote central station service transmitter provided under another contract.
  - 4. Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACP and any required remote annunciators, indicating the location and type of device.
  - 5. General Alarm: A system general alarm shall include:
    - a) Indication of alarm condition at the FACP and any required remote annunciator(s).

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- b) Identification of the device that is the source of the alarm at the FACP and any required remote annunciator(s).
  - c) Operation of audible and visible notification appliances throughout the building until silenced at FACP. Audible Alarm Notification shall operate Temporal Code.
  - d) Closing doors normally held open by magnetic door holders.
  - e) Unlocking designated doors.
  - f) Shutting down supply and return fans serving zone where a alarm is initiated.
  - g) Closing smoke dampers on system serving zone where a alarm is initiated.
  - h) Initiation of smoke control sequence.
  - i) Notifying the local fire department.
  - j) Initiation of elevator recall in accordance with ASME/ANSI A17.1, when specified sensors are activated.
6. Supervisory Operations: Upon activation of a supervisory device such as fire pump power failure, low air pressure switch, and tamper switch, the system shall operate as follows:
- a) Activate the system supervisory service audible signal and illuminate the LED at the FACP and the remote annunciator.
  - b) Pressing the Supervisory Acknowledge key will silence the supervisory audible signal while maintaining the Supervisory LED "on" indicating off-normal condition.
  - c) Record the event in the FACP historical log.
  - d) Transmission of supervisory signal to remote central station.
7. Alarm Silencing: If the "Alarm Silence" button is pressed, all audible alarm signals shall cease operation.
8. System Reset
- a) The "System Reset" button shall be used to return the system to its normal state. Display messages shall provide operator assurance of the sequential steps ("IN PROGRESS", "RESET COMPLETED") as they occur. The system shall verify all circuits or devices are restored prior to resetting the system to avoid the potential for re-arming the system. The display message shall indicate "ALARM PRESENT, SYSTEM RESET ABORTED."
  - b) Should an alarm condition continue, the system will remain in an alarmed state.
9. Drill: A manual evacuation (drill) switch shall be provided to initiate an alarm on the FACP.
10. Manual Control: Manual controls shall be supervised so that an "off normal" position of any switch shall cause an "off normal" system trouble. The "off normal" status shall be clearly identified in plain-language on the FACP alphanumeric display.
- a) Manual Bypass Control: The ability to perform a manual bypass of selected automatic functions shall be provided.
  - b) Circuit Enable/Disable Control: The system shall have provisions for disabling and enabling each circuit individually for maintenance or testing purposes.
11. WALKTEST: The system shall have a one person test feature. Enabling the one person test

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feature at the FACP shall activate the "One Person Testing" mode of the system as follows:

- a) The city circuit connection and suppression release circuits shall be bypassed for the testing group.
- b) Control relay functions associated to the testing group shall be bypassed.
- c) The FACP shall indicate a trouble condition.
- d) The alarm activation of any initiation device in the testing group shall cause the audible notification appliances to sound a code to identify the device.
- e) The control panel shall automatically reset itself after signaling is complete.
- f) Any momentary opening of an initiating or notification appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating the trouble condition.

G. Analog Smoke Sensors:

1. Monitoring: FACP shall individually monitor sensors for calibration, sensitivity, and alarm condition, and shall individually adjust for sensitivity. The FACP shall determine the condition of each sensor by comparing the sensor value to the stored values. Device addressing shall not require any special tools or programming devices.
2. Environmental Compensation: The FACP shall maintain a moving average of the sensor's smoke chamber value to automatically compensate for dust, dirt, and other conditions that could affect detection operations.
3. Programmable Sensitivity: Photoelectric Smoke Sensors shall have 8 sensitivity levels ranging from 0.2% to 3.7%, programmed and monitored from the FACP.
4. Sensitivity Testing Reports: The FACP shall provide sensor reports that meet NFPA 72 calibrated test method requirements. The reports shall be viewed on a Maintenance Terminal CRT Display or printed for annual recording and logging of the calibration maintenance schedule.
5. Peak Value Logging: The FACP shall log the Peak Value of smoke obscuration or degree of temperature for each individual sensor to allow system calibration for maximum response time performance without nuisance alarms based on "actual ambient conditions".
6. The FACP shall automatically indicate when an individual sensor needs cleaning. The system shall provide a means to indicate that a sensor requires cleaning. When a sensor's average value reaches a predetermined value, (3) progressive levels of reporting are provided. The first level shall indicate that a sensor is close to a trouble reporting condition and will be indicated on the FACP as "ALMOST DIRTY." This condition provides a means to alert maintenance staff of a dirty sensor without creating a trouble in the system. If this indicator is ignored, a second level "DIRTY SENSOR" condition shall be indicated at the FACP. The sensor base LED shall glow steady giving a visible indication at the sensor location. The "DIRTY SENSOR" condition shall not affect the sensitivity level required to alarm the sensor. If a "DIRTY SENSOR" is left unattended, and its average value increases to a third predetermined value, an "EXCESSIVELY DIRTY SENSOR" trouble condition shall be indicated at the control panel.
7. The FACP shall continuously perform an automatic self-test on each sensor which will check sensor electronics and ensure the accuracy of the values being transmitted. Any sensor that fails this test shall indicate a "SELF TEST ABNORMAL" trouble condition.

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- H. Duct Smoke Detector: Activation of a duct smoke detector shall initiate a supervisory alarm at the system control panel and at the remote annunciator. Duct smoke detector activation shall also initiate an air handler unit shutdown as required by NFPA 90A.
- I. Audible Alarm Notification: By horns in areas as indicated on drawings.
- J. Power Requirements
  - 1. The control panel shall receive AC power via a dedicated circuit breaker.
  - 2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of 24 hours with 5 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.
  - 3. All circuits requiring system-operating power shall be 24 VDC and shall be individually fused at the control panel.
  - 4. The incoming power to the system shall be supervised so that any power failure will be indicated at the control panel. A green "power on" LED shall be displayed continuously while incoming power is present.
  - 5. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be indicated at the control panel.
  - 6. The system shall support 100% of addressable devices in alarm operated at the same time, under both primary (AC) and secondary (battery) power conditions.
  - 7. Loss of primary power shall sound a trouble signal at the FACP. FACP shall indicate when the system is operating on an alternate power supply.

#### 1.6 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 01 Specification Sections.
  - 1. Product data sheets for system components highlighted to indicate the specific products, features, or functions required to meet this specification. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.
  - 2. Wiring diagrams from manufacturer.
  - 3. Shop drawings: Provide shop drawings showing equipment/device locations and connecting wiring of entire fire alarm system. Include wiring and riser diagrams, the candela values for all strobes and full battery & voltage drop calculations for the system. The shop drawings for the fire alarm system shall be performed and signed by a NICET Level 3 person or licensed professional engineer.
  - 4. System shall be designed with spare capacity. A minimum of 25% spare capacity shall be incorporated into each SLC, NAC and amplifier circuit.
  - 5. System Power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate per the prescribed backup time periods and under all voltage conditions per all applicable standards.
  - 6. System operation description including method of operation and supervision of each type of



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circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of SLC, NAC, RAC, Sensor, and auxiliary control circuits.

7. Operating instructions for FACP.
8. Operation and maintenance data for inclusion in Operating and Maintenance Manual. Include data for each type product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations.
9. Record of field tests of system.
10. Record Shop Drawings: A final fire alarm shop drawing as-built will be required at the completion of construction. This as-built must show all devices, their address (NAC or SLC) and the wiring configuration; wiring configuration means to show the notification and initiation wiring sequence from device to device, not the actual wiring location in the building. The goal is to have an accurate shop drawing showing how the fire alarm system was physically wired in the building.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A factory authorized installer is to perform the work of this section.
- B. The equipment and installation supervision furnished under this specification is to be provided by a manufacturer who has been engaged in production of this type (software driven) of equipment for at least ten (10) years, and has a fully-equipped service organization within fifty (50) miles of the installation.
- C. The system controls shall be UL listed for Power Limited Applications per NEC 760. All circuits must be marked in accordance with NEC article 760-23.
- D. Installer's Qualifications: Firm with at least 5 years of successful installation experience on projects with fire alarm systems work similar to that required for this project. At least one NICET Level 2 technician shall be on site at all times during the fire alarm installation. The installer shall have a NICET Level 3 technician visit the site at least one time per week during the fire alarm installation to review and approve the installation.
  1. Firm with manufacturer's factory trained personnel.
  2. Firm with factory authorized service organization and spare parts stock.
  3. All control equipment must have transient protection devices to comply with UL 864 requirements. In addition to the UL-UOJZ requirement mentioned above, the system controls shall be UL listed for Power Limited Applications per NEC 760. All circuits must be marked in accordance with NEC article 760.
- E. Each and all items of the Fire Alarm System shall be listed as a product of a single fire alarm system manufacturer under the appropriate category by Underwriters Laboratories, Inc. (UL), and shall bear the "UL" label.

#### 1.8 EXTRA MATERIALS

- A. General: Furnish extra materials, packaged with protective covering for storage, and identified with labels clearly describing contents as follows (separate extra materials shall be provided for

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each school based on the quantities for each school):

1. Manual Stations & Lexan Covers: Furnish quantity equal to 5 percent of the number of manual stations and covers installed, but not less than two.
2. Strobe Units: Furnish quantity equal to 1 percent of the number of units installed, but not less than two. Separate attic stock shall be provided for wall and ceiling devices.
3. Speaker/Strobe Units: Furnish quantity equal to 1 percent of the number of units installed, but not less than two. Separate attic stock shall be provided for wall and ceiling devices.
4. Smoke and Heat Detectors: Furnish quantity equal to 5 percent of the number of units of each type installed but not less than two of each type.
5. Sensor Bases: Furnish quantity equal to 1 percent of the number of units of each type installed but not less than two of each type.
6. Addressable Monitoring Devices and Control Modules: Furnish quantity equal to 2 percent of the number of units of each type installed but not less than two of each type.

#### 1.9 WARRANTY

- A. The Contractor shall provide the Owner with a 2-year warranty on all materials, labor and systems from the date of Substantial Completion. The date of Substantial completion will be as set in a letter issued by the Architect – no exceptions.
- B. During the course of the 2-year warranty period, the contractor shall provide a full service contract, including all labor and materials. In addition, the contractor shall provide full NFPA 72 required testing and maintenance services during the 2-year warranty period including semi-annual and annual NFPA-72 testing and certification requirements. NFPA 72 testing and maintenance certified reports shall be submitted to the District for record.

#### PART 2 – PRODUCTS

##### 2.1 COMBINATION FIRE ALARM – MASS NOTIFICATION CONTROL PANEL (FACP) – Simplex by Johnson Controls 4100ES

- A. General: Comply with UL 864, "Control Units and Accessories for Fire Alarm Systems".
- B. The following FACP hardware shall be provided:
  1. Power Limited base panel with platinum cabinet and door, 120 VAC input power.
  2. 2,500 point capacity where (1) point equals (1) monitor (input) or (1) control (output).
  3. 2000 points of annunciation where one (1) point of annunciation equals:
    - a) 1 LED driver output on a graphic driver or 1 switch input on a graphic switch input module.
    - b) 1 LED on panel or 1 switch on panel.
  4. 9 Amp Power Supply minimum with temperature compensated, dual-rate battery charger capable of charging up to 110 Ah batteries without a separate external battery charger. Battery charger voltage and amperage values shall be accessible on the FACP LCD display.

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5. One Auxiliary electronically resettable fused 2A @24VDC Output, with programmable disconnect operation for 4-wire detector reset.
6. One Auxiliary Relay, SPDT 2A @32VDC, programmable as a trouble relay, either as normally energized or de-energized, or as an auxiliary control.
7. Class B Addressable Notification Appliance Signaling Line Circuits (SLCs).
  - a) Each Addressable Notification Appliance SLC shall be rated at 3A and capable of supporting up to 127 Notification Appliances per channel.
  - b) Wiring shall be 18 AWG to 12 AWG unshielded twisted pair wire. Systems that require shielded wire for Notification Appliances shall not be accepted.
  - c) A constant voltage under both primary and secondary power conditions shall be maintained at the notification appliance field wiring terminal connections in the FACP to ensure the voltage drop on the circuit is consistent under both primary and secondary power conditions.
  - d) For systems that do not provide a constant voltage source at the FACP notification appliance field wiring terminal connections, the fire alarm contractor shall:
    - (a) Provide separate point-to-point voltage drop calculations for all notification appliances under worst case secondary power specifications, and
    - (b) Perform a complete functional test of all notification appliances under worst case secondary power conditions.
8. Class B Notification Appliance Circuits (NAC; rated 3A@24VDC, resistive).
  - a) NAC's shall be conventional reverse polarity operation and shall be for synchronized strobes and independent horn/strobe operation over two wires.
  - b) NACs shall be selectable as auxiliary power outputs derated to 2 A for continuous duty.
  - c) Strobe synchronization and audible cadence synchronization shall be across all panel NAC circuits. Systems that cannot provide listed synchronization across all panel NAC's shall not be acceptable.
9. Where required provide Intelligent Remote Battery Charger for charging up to 50Ah batteries.
10. Expansion Power Supplies with Class B integral Intelligent Addressable Notification Appliance Signaling Line Circuits (SLCs) for system expansion. Expansion power supplies shall provide complete capability as the primary power supply.
11. Power Supplies with integral conventional reverse polarity Notification Appliance Circuit Class B for system expansion. Expansion power supplies shall provide complete capability as the primary power supply.
12. The FACP shall support up to (5) RS-232-C ports and one service port. All (5) RS-232 Ports shall be capable of two-way communications.
13. Remote Unit Interface: supervised serial communication channel for control and monitoring of remotely located annunciators and I/O panels.
14. Programmable DACT for either Common Event Reporting or per Point Reporting.

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15. Fire Panel Internet Interface to provide supplemental notification and remote user access to the FACP using Ethernet and TCP/IP communications protocol compatible with IEEE Standard 802.3.
- C. Cabinet: Lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control unit, provide exactly matching modular unit enclosures.
- D. Alphanumeric Display and System Controls: Panel shall include a Touch Screen Display with both soft and hard keys and a resistive-touch LCD display to indicate alarm, supervisory, and component status messages and shall include a keypad for use in entering and executing control commands.
  1. The system shall have the capability to provide expanded content, multi-line, operator interface displays as indicated on the drawings and specifications. The expanded content multi-line displays shall be Quarter-VGA (QVGA) or larger and be capable of supporting a minimum of 854 standard ASCII characters to minimize or eliminate the levels of navigation required for access to information when responding to critical emergencies and abnormal system conditions. The QVGA operator interface shall provide operator prompts and six context sensitive soft-keys for intuitive operation.
    - a) Expanded content, multi-line operator interfaces shall be capable of providing the following functions:
      - (a) Dual language operation with Instant-Switch language selection during runtime.
      - (b) Activity display choices for:
        - (i) First 8 Events.
        - (ii) First 5 Events and Most Recent Event (with first and most recent event time and date stamps).
        - (iii) First Event and Most Recent Event (with first and most recent event time and date stamps).
        - (iv) Scrollable List Display displays a scrollable list of active points for the event category (alarm, priority 2, supervisory, or trouble) selected. The position in this list will be the last acknowledged point (not flashing) at the top followed by the next 7 unacknowledged points (flashing).
        - (v) General Event Status (alarm, priority 2, supervisory, or trouble in system)
        - (vi) Site Plan
      - (c) Equal or hierarchal priority assignment. In systems with two or

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more operator interfaces, each operator interface shall be programmable to allow multiple operator interfaces to have equal operation priority or to allow hierarchical priority control to be assigned to individual operator interfaces (locations).

(d) Up to 50 custom point detail messages for providing additional point specific information in detailed point status screens.

- b) Expanded content, multi-line displays shall have the capability to provide Dual-Language operation as indicated on the drawings and specifications.

(a) Language selection shall be via a switch on the operator interface panel. Operator interface panels shall support instant-language-switchover during runtime to allow the operator to toggle between languages each time the language selection switch is operated, without requiring complicated multi-step processes.

(b) Both one-byte and two-byte characters shall be supported.

- E. Distributed Module Operation: FACP shall be capable of allowing remote location of the following modules; interface of such modules shall be through a Style 4 (Class B) supervised serial communications channel (SLC):

1. Addressable Signaling Line Circuits
2. Initiating Device Circuits
3. Notification Appliance Circuits
4. Auxiliary Control Circuits
5. Graphic Annunciator LED/Switch Control Modules

- a) In systems with two or more Annunciators and/or Command Centers, each Annunciator/Command Center shall be programmable to allow multiple Annunciators/Command Centers to have equal operation priority or to allow hierarchical priority control to be assigned to individual Annunciator/Command Center locations.

6. Amplifiers, voice and telephone control circuits

- F. Voice Alarm: Provide an emergency communication system, integral with the FACP, including voice alarm system components, microphones, amplifiers, and tone generators. Features include:

1. Amplifiers comply with UL 1711, "Amplifiers for Fire Protective Signaling Systems." Amplifiers shall provide an onboard local mode temporal coded horn tone as a default backup tone. Test switches on the amplifier shall be provided to test and observe amplifier backup switchover. Each amplifier shall communicate to the host panel amplifier and NAC circuit voltage and current levels for display on the user interface. Each amplifier shall be capable of performing constant supervision for non-alarm audio functions such as background music and general paging.
2. Dual alarm channels permit simultaneous transmission of different announcements to different zones or floors automatically or by use of the central control microphone. All announcements are made over dedicated, supervised communication lines. All risers shall support Class B wiring for each audio channel.

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3. Eight channel digitally multiplexed audio for systems that require more than two channels of simultaneous audio. Up to 8 channels of audio shall be multiplexed on either a style 4 or style 7 twisted pair.
4. Emergency voice communication audio controller module shall provide up to 32 minutes of message memory for digitally stored messages. Provide supervised connections for master microphone and up to 5 remote microphones.
5. Status annunciator indicating the status of the various voice alarm speaker zones and the status of fire fighter telephone two-way communication zones.
6. When required, Redundant Voice Command Centers shall be capable of generating voice paging from more than one node in a network audio system.

G. Evacuation System - Non-Alarm Audio

1. The fire alarm control unit shall provide non-alarm audio from an owner supplied paging and/or music source over the fire alarm evacuation speakers. This feature shall be an integral part of the fire alarm system, and shall use some or all of the audio components from the fire alarm evacuation system.
2. The fire alarm system and the non-alarm audio operation shall comply with NFPA 72 requirements for non-emergency purposes at a fire command center that is not constantly attended by a trained operator.
3. All fire alarm system hardware and software shall be U.L. listed for non-alarm audio use. The fire alarm system shall supervise for system hardware and field wiring faults while playing non-alarm audio over the evacuation speakers. Any hardware failure or speaker circuit fault detected when the system is playing non-alarm audio shall report a trouble on the fire alarm control unit. All audio components used for both the non-alarm audio and the fire alarm evacuation system shall be manufactured by the same supplier.
4. The non-alarm audio shall have two dedicated audio inputs to the fire alarm control unit. Terminal strip connections and an industry standard RCA receptacle shall be provided at the fire alarm control unit for terminating the owner's audio source. The fire alarm input shall be 600-Ohm impedance. The inputs on the fire alarm control unit shall be electrically isolated via an isolation transformer.
5. The fire alarm control unit shall accept industry standard "line level audio input" from the owner's non-alarm audio source. The fire alarm system hardware and software shall distribute the audio over the fire alarm evacuation speakers. The selection of which speaker zones to distribute the non-alarm audio to the building occupants shall be coordinated with the owner's representative.
6. The fire alarm control unit shall be able to make audio input level adjustments from the owner's non-alarm audio source. This adjustment will match the non-alarm audio source to the fire alarm input. After the audio levels are adjusted, the owner shall control the volume level from the non-alarm audio source.
7. The fire alarm system will have the capability to provide operator "keys" that will adjust the volume level of pre-assigned non-alarm audio zones. The volume level of non-alarm audio that is being broadcast to any audio zone will also be individually adjustable by time of day via a pre-specified schedule.
8. The non-alarm audio shall be the lowest priority audio on the fire alarm system. The non-alarm audio shall not interfere with any of the fire alarm emergency signals that may include live voice, pre-recorded emergency voice messages, or any alert tones. Switches shall be located on the fire alarm control unit to turn on or off the non-alarm audio system feature. The fire

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a alarm control unit shall have LED lamps to indicate the ON vs. OFF status of the non-alarm audio feature. Speaker circuits that are actively broadcasting non-alarm audio will also be indicated by LEDs.

9. The non-alarm audio shall be synchronized throughout the fire alarm life safety system amplifiers and speaker circuits. Any remote amplifier panels located on the fire alarm system network shall also be synchronized. The system shall be capable of accepting a system-wide non-alarm audio input at the main fire alarm control or another local non-alarm audio input at a remote amplifier panel to serve only the areas served by that remote panel.
10. Multiple non-alarm audio sources must be accessible by the fire alarm non-alarm audio system. Each separate non-alarm audio source will have the ability to be broadcast into a distinct fire zone, depending on occupant preference. Any system restricted to a limited number of non-audio sources will not be accepted. The system must have the capability of broadcasting an unlimited number of non-alarm sources, except as determined by the number of individual fire zones served by the fire alarm system.
11. Non-alarm audio shall be automatically turned off in the event of primary power failure to the fire alarm control unit or any of the remote amplifier panels controlled by the main fire alarm control unit.

## 2.2 ADDRESSABLE INITIATING

### A. ADDRESSABLE MANUAL PULL STATIONS

1. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
2. Description: Addressable double- action type, red LEXAN. Station shall mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units. Station shall be pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit. Where double-action stations are provided, the mechanism shall require two actions push top activation door to initiate an alarm.
3. Provide with a front showing red LED showing that will flash each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the station LED shall be on steady.
4. Indoor Protective Shield: Where required, or as indicated on the drawings, provide a factory-fabricated, tamperproof, clear LEXAN enclosure shield and red frame that easily fits over manual pull stations which shall be hinged at the top to permit lifting for access to initiate a local alarm. Unit shall be NRTL listed. Lifting the cover shall actuate an integral battery-powered audible horn intended to discourage false-alarm operation. The horn shall be silenced by lowering and realigning the shield. The horn shall provide 85dB at 10 feet and shall be powered by a 9 VDC battery.
5. California Building Code, Title 24: Where required pull station shall be operable with one hand and shall not require tight grasping, pinching or twisting of the wrist. Provides a more easily operated pull station lever compared to standard stations.
6. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

### B. ADDRESSABLE ANALOG SMOKE SENSORS

1. General Requirements for System Smoke Detectors:

- a) Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems." Include the following features:
- b) Factory Nameplate: Serial number and type identification.
- c) Operating Voltage: 24 VDC, nominal and shall be two-wire type.
- d) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore normal operation.
- e) Each sensor base shall contain a magnetically actuated test switch to provide for easy pre-certification alarm testing at the sensor location.
- f) Each sensor shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a "wrong device", the control unit shall operate with the installed device at the default alarm settings for that sensor; 2.5% obscuration for photoelectric sensor, 135-deg F and 15-deg F rate-of-rise for the heat sensor, but shall indicate a "Wrong Device" trouble condition.
- g) Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit. Provide multiple levels of detection sensitivity for each sensor.
- h) Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct smoke sensor shall be provided by the FACP.
- i) The sensor's electronics shall be immune from nuisance alarms caused by EMI and RFI. Removal of the sensor head for cleaning shall not require the setting of addresses.
- j) Bases: CO Sensor, relay output, sounder and isolator bases shall be supported alternatives to the standard base.

2. Addressable Sensor Bases

- a) Standard base - Twist lock addressable base with address selection DIP switch accessible from front with sensor removed. Integral red LED for power-on (pulsing), or alarm or trouble (steady on). Locking anti-tamper design mounts on standard outlet box.
- b) Sensor Base with remote device connection - All standard base features with wired connection for either a Remote LED alarm indicator or remote relay (relay is unsupervised and requires separate 24VDC)
- c) Supervised Relay Bases - All standard base features and shall be available in either a 4-Wire Sensor Base to use with remote or locally mounted relay; requires separate 24 VDC, or as a 2-Wire Sensor Base to use with remote or locally mounted relay; no separate power required. Supervised relay operation shall be programmable and shall be manually operated from control panel.
- d) Sensor base with built-in electronic alarm sounder - All standard base features and piezoelectric sounder shall provide high output (88 dBA) with low current requirements (20 mA). Sounder shall be synchronized via SLC communications or by the NAC if NAC powered, sounder shall operation shall be programmable



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and shall be manually operated from control panel.

- e) 520 Hz Sensor base with built-in electronic low frequency sounder - All standard base features and piezoelectric sounder shall provide a low frequency 520 Hz Square Wave (85 dBA) with nominal current requirements (115 mA). Sounder shall be synchronized via SLC communications or by the NAC if NAC powered, sounder operation shall be programmable and shall be manually operated from control panel.

- (a) Emitted tone shall be a 520Hz Square Wave signal in compliance with the requirements of the 2010 edition of NFPA 72 for sleeping areas.

- (b) The 520Hz Sounder base shall be listed to UL 268 and UL464, Audible Signal Appliances.

C. ADDRESSABLE DUCT SMOKE SENSOR

1. Standard Addressable Duct Smoke Sensor Unit. Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Duct housing shall include relay or relay driver as required for fan shutdown.
  - a) Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct smoke sensor shall be provided by the FACP.
  - b) The Duct Housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable independent of the sensor head for activation by other alarm initiating devices within the fire alarm system. Relay shall be mounted within 3 feet of HVAC control circuit.
  - c) Duct Housing shall provide a magnetic test area and Red sensor status LED and Duct Housing shall provide a relay control Yellow LED trouble indicator.
  - d) Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.
  - e) Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.
  - f) For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
  - g) Each duct smoke sensor shall be provided with a Remote Test Station with an alarm LED and test switch.
  - h) Where indicated provide a NEMA 4X weatherproof duct housing enclosure that shall provide for the circulation of conditioned air around the internally mounted addressable duct sensor housing to maintain the sensor housing at its rated temperature range. The housing shall be UL Listed to Standard 268A.
2. Addressable In-Duct Mounted Smoke Sensors. Photoelectric type, for applications with controlled dust and humidity providing HVAC duct smoke sensing where sampling tube

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designs are not appropriate. In-Duct housing shall include relay or relay driver as required for fan shutdown.

- a) Shall accommodate duct airflow from 0 to 4000 ft/min (0 to 1220 m/min), and provide environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct smoke sensor by the FACP.
- b) The In-Duct Housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable independent of the sensor head for activation by other alarm initiating devices within the fire alarm system. Relay shall be mounted within 3 feet of HVAC control circuit.
- c) Standard models shall be for rectangular ducts from 6" (152 mm) square to 36" (914 mm) square with optional adapters available to allow use with round ducts of 6", 8" (203 mm), 10" (254 mm) or 12" (305 mm) in diameter.
- d) In-Duct Housing shall provide a magnetic test area and Red sensor status LED and In-Duct Housing shall provide a relay control Yellow LED trouble indicator.
- e) Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.
- f) Each duct smoke sensor shall be provided with a Remote Test Station with an alarm LED and test switch.

D. ADDRESSABLE HEAT SENSORS

- 1. General Requirements for Heat Detectors: Comply with UL 521.
- 2. Thermal Sensor Combination type: Fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.
- 3. Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag. Selectable rate compensated, fixed temperature sensing with or without rate-of-rise operation.
- 4. Mounting: Twist-lock base interchangeable with smoke-sensor heads.
- 5. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- 6. Sensor fixed temperature sensing shall be independent of rate-of-rise sensing and programmable to operate at 135-deg F or 155-deg F. Sensor rate-of-rise temperature detection shall be selectable at the FACP for either 15-deg F or 20-deg F per minute.
- 7. Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32-deg F to 155-deg F.
- 8. Unless otherwise indicated, sensors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for temperature by fire-alarm control unit.
  - a) Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.

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- b) Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).

E. ADDRESSABLE MULTI-POINT/MULTI-SENSOR/MULTI-CRITERIA SENSOR

1. Smoke and carbon monoxide sensing shall be available to be combined in a single housing to provide smoke activity accurately monitored by photoelectric sensing technology and carbon monoxide activity accurately monitored by thermistor sensing technology.
2. A correlation algorithm of smoke activity and CO activity shall be provided for intelligent fire detection earlier than with either technology activity alone but shall provide software and programming capabilities to help reduce nuisance alarms.
3. Individual sensor information shall be processed by the host fire alarm control unit to determine sensor status and to determine whether conditions are normal, off-normal, or alarm.
4. Analog information from each sensor type shall be digitally communicated to the control panel where it is to be analyzed. Photoelectric sensor input is to be stored and tracked as an average value with an alarm or abnormal condition being determined by comparing the sensor's present value against its average value. CO data is to be processed to look for absolute values.
5. Monitoring each photoelectric sensor's average value shall provide a software filtering process that compensates for environmental factors (dust, dirt, etc.) and component aging, which shall provide an accurate reference for evaluating new activity. The intent of this process is to be a significant reduction in the probability of false or nuisance alarms caused by shifts in sensitivity, either up or down. Status indications of dirty and excessively dirty shall be automatically generated allowing maintenance to be performed on a per device basis.
6. Peak activity per sensor shall be stored by the host fire alarm control unit to assist in evaluating specific locations where the alarm set point for each sensor shall be capable of being determined at the control panel, and selectable as more or less sensitive as the individual application requires.
7. Alarm set points shall be programmed for timed automatic sensitivity selection (such as more sensitive at night, less sensitive during day). Control panel programming shall also provide multi-stage operation per sensor, for example a 0.2% level may cause a warning to prompt investigation while a 2.5% level may initiate an alarm.
8. Bases: CO Sensor, relay output, with no sound.

F. ADDRESSABLE CIRCUIT INTERFACE MODULES

1. Addressable Circuit Interface Modules: Arrange to monitor or control one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices, and for control of AHU systems.
2. Addressable Circuit Interface Modules will be capable of mounting in a standard electric outlet box. Modules will include cover plates to allow surface or flush mounting. Modules will receive their operating power from the signaling line circuit or a separate two wire pair running from an appropriate power supply, as required.
3. There shall be the following types of modules:
  - a) Type 1: Monitor Circuit Interface Module:

(a) For conventional 2-wire smoke detector and/or contact device monitoring with Class B or Class A wiring supervision. The supervision of the zone wiring will be Class B. This module will communicate status (normal, alarm, trouble) to the FACP.

(b) For conventional 4-wire smoke detector with Class B wiring supervision. The module will provide detector reset capability and over-current power protection for the 4-wire detector. This module will communicate status (normal, alarm, trouble) to the FACP.

b) Type 2: Line Powered Monitor Circuit Interface Module

(a) This type of module is an individually addressable module that has both its power and its communications supplied by the two wire signaling line circuit. It provides location specific addressability to an initiating device by monitoring normally open dry contacts. This module shall have the capability of communicating four zone status conditions (normal, alarm, current limited, trouble) to the FACP.

(b) This module shall provide location specific addressability for up to five initiating devices by monitoring normally closed or normally open dry contact security devices. The module shall communicate four zone status conditions (open, normal, abnormal, and short). The two-wire signaling line circuit shall supply power and communications to the module.

c) Type 3: Single Address Multi-Point Interface Modules

(a) This multipoint module shall provide location specific addressability for four initiating circuits and control two output relays from a single address. Inputs shall provide supervised monitoring of normally open, dry contacts and be capable of communicating four zone status conditions (normal, open, current limited, and short). The input circuits and output relay operation shall be controlled independently and disabled separately.

(b) This dual point module shall provide a supervised multi-state input and a relay output, using a single address. The input shall provide supervised monitoring of two normally open, dry contacts with a single point and be capable of communicating four zone status conditions (normal, open, current limited, and short). The two-wire signaling line circuit shall supply power and communications to the module.

(c) This dual point module shall monitor an unsupervised normally open, dry contact with one point and control an output relay with the other point, using a single address. The two-wire signaling line circuit shall supply power and communications to the module.

d) Type 4: Line Powered Control Circuit Interface Module

(a) This module shall provide control and status tracking of a Form "C" contact. The two-wire signaling line circuit shall supply power and

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communications to the module.

e) Type 5: 4-20 mA Analog Monitor Circuit Interface Module

(a) This module shall communicate the status of a compatible 4-20 mA sensor to the FACP. The FACP shall annunciate up to three threshold levels, each with custom action message; display and archive actual sensor analog levels; and permit sensor calibration date recording.

4. All Circuit Interface Modules shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACP. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

## 2.3 NOTIFICATION

### A. ALARM NOTIFICATION APPLIANCES

1. Notification Appliances: The Contractor shall furnish and install Notification Appliances and accessories to operate on compatible signaling line circuits (SLC).
  - a) Notification appliance operation shall provide power, supervision and separate control of horns and strobes over a single pair of wires. The controlling channel (SLC) digitally communicates with each appliance and receives a response to verify the appliance's presence on the channel. The channel provides a digital command to control appliance operation. SLC channel wiring shall be unshielded twisted pair (UTP), with a capacitance rating of less than 60pf/ft and a minimum 3 twists (turns) per foot.
  - b) All Notification Appliances shall operate as a completely independent device allowing for specific location alerting of both fire alarm and Mass Notification functions. Each visible device (both clear fire alarm and amber mass notification) shall be capable of operating on multiple notification zones or completely separate from all other notification devices, this allows "On the fly" program operation changes for Mass Notification alerting and fire alarm notification.
  - c) All Notification Appliances shall operate as a completely independent device allowing for appliances in handicap accessible rooms and other locations to operate on the same SLC and to activate individually based on an alarm condition in a room or as part of a general alarm condition where all appliances activate together.
  - d) Individual Notification Appliances shall be able to be grouped into zones (or operational groups) by central programming at the main fire alarm control unit.
  - e) Notification Appliances shall provide for "unobtrusive" testing. Each Notification Appliance shall be tested for audible and visible operation on an individual basis at the device or from the main fire alarm control unit, allowing for minimal invasive impact.
  - f) Both wall mount and ceiling mount devices shall be available.
2. LED Visible Only: LED visible strobe (V/O) shall be listed to UL 1971. The multi-candela

LED V/O strobe device shall be available in low (15, 30, 75 cd) and high (110, 135, 185 cd) range candela. Models shall provide a small compact design with low current draw due to efficient strobe LED's. LED strobe device shall consist of two pieces; cover and appliance/mounting plate. For ease of installation the appliance/mounting plate shall mount directly to a standard single gang electrical box, without the use of special adapter or trim rings. Synchronized LED strobe operation shall be provided with other LED or Xenon strobe devices on the same circuit or the same panel on different circuits. LED strobe device shall meet the 20ms pulse width requirement in the 2016 Edition of NFPA 72. When the appliance is connected to an active circuit, the front cover of the appliance shall be removable without causing a trouble indication on the fire alarm control unit. The Candela levels shall be settable from the fire alarm control unit or by using a hardware selector on the appliance. Weatherproof model shall mount to provided single gang weatherproof electrical box.

3. Speaker: Speaker notification appliances shall be listed to UL 1480. Individual device level supervision and activation control shall be provided by the fire alarm control unit.
  - a) Speakers shall be individually powered, addressed, and controlled from a compatible fire alarm control unit Signaling Line Circuit (SLC) using Unshielded Twisted Pair (UTP) cable.
  - b) Speakers shall provide for Fire Alarm and General Signaling functionality in a single unit, eliminating additional devices. Device "Self-Test" shall be supported by a compatible fire alarm control unit and shall be UL listed and NFPA 72 compliant. Speakers shall be UL listed to provide a 520Hz audio tone in compliance with NFPA 72 for sleeping areas.
  - c) The speaker audio shall be provided by a standard 25VRMS or 70.7VRMS audio circuit using Unshielded Twisted Pair (UTP) cable.
  - d) Speaker power taps shall be at a minimum of 0.25W, 0.50W, 1.0W and 2.0W. At the 1.0W tap, the speaker shall have a minimum UL rated sound pressure level of 86dBA at 10 feet for the Standard Output version and 84dBA at 10 feet for the High Fidelity version.
  - e) Speakers shall be available in either "Standard Output" with a minimum frequency response of 400 to 4000 Hz or in "High Fidelity Output" with a minimum frequency response of 200 to 10,000 Hz. Standard Output speakers shall use a multi-tapped speaker for audio/tone notification.
  - f) Wall mount appliances shall be available in White and ceiling mount appliances shall be available in White. Labeling shall be "ALERT".
  - g) The speaker shall install directly to a 4" square, 2 1/8" deep electrical box. Extensions for these boxes shall not be required. Units shall be modular in design to allow for easy installation and for easy changing of device color and labeling.
4. Speaker/Visible: Combination Speaker/Visible (S/V) units combine the speaker and visible functions into a common housing. The S/V shall be listed to UL 1971 and UL 1480. Addressable functionality controls visible operation, while the speaker shall operate on a 25VRMS or 70.7VRMS NAC.
  - a) Operational functions and features of Speaker above shall apply to this section. Operational functions and features of Strobe above shall apply to this section.
  - b) Wall mount appliances shall be available in White and ceiling mount appliances shall be available in White. Labeling shall be "ALERT".

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- c) The speaker shall install directly to a 4" square, 2 1/8" deep electrical box. Extensions for these boxes shall not be required. Units shall be modular in design to allow for easy installation and for easy changing of device color and labeling
- 5. Isolator Module: Isolator module provides short circuit isolation for addressable notification appliance SLC wiring. Isolator shall be listed to UL 864. The Isolator shall mount directly to a minimum 2 1/8" deep, standard 4" square electrical box, without the use of special adapter or trim rings. Power and communications shall be supplied by the Addressable Controller channel SLC; dual port design shall accept communications and power from either port and shall automatically isolate one port from the other when a short circuit occurs. The following functionality shall be included in the Isolator module:
  - a) Report faults to the host FACP.
  - b) On-board Yellow LED provides module status.
  - c) After the wiring fault is repaired, the Isolator modules shall test the lines and automatically restore the connection.
- 6. Accessories: The contractor shall furnish the necessary accessories.

B. ADDRESSABLE APPLIANCE SLC REPEATER

- 1. Addressable Repeater shall supervise channel (SLC) wiring and communicate with and control addressable notification appliances. The Repeater shall be a stand-alone panel capable of powering one (1) NAC SLC. The channel (SLC) shall be rated for 3 amps and support up to 127 addresses. Power and communication for the notification appliances shall be provided on the same pair of wires. It shall be possible to program the High/Low setting of the audible (horn) appliances by channel from the addressable controller.
  - a) The Repeater shall provide a constant voltage output to ensure NAC current and voltage do not vary whether the panel is operating on AC or battery. The output voltage during a alarm conditions shall be 29 VRMS.
  - b) Addressable SLC notification appliance circuits shall be Class B, Style 4 Class A, Style 6.
  - c) For Class B circuits, the Repeater shall support up to 4 Class B branches directly at its output terminals for one SLC.
  - d) The internal power supply and battery charger shall be capable of charging up two 12.7 Ah batteries internally mounted or 25Ah batteries mounted in an external cabinet.
  - e) The Repeater panel can be mounted close to the host fire alarm control unit or remotely.
  - f) The Repeater status shall be communicated to the host fire alarm control unit and locally indicated.
  - g) A 200mA auxiliary output shall be available
  - h) The Repeater shall be listed to UL 864

2.4 REMOTE LCD ANNUNCIATOR

- A. Provide a remote LCD Annunciator, where required, with the same "look and feel" as the FACP operator interface. The Remote LCD Annunciator shall use the same Primary Acknowledge,

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Silence, and Reset Keys; Status LEDs and LCD Display as the FACP.

- B. Annunciator shall have super-twist LCD display with two lines of 40 characters each. Annunciator shall be provided with four (4) programmable control switches and associated LEDs.
- C. Under normal conditions the LCD shall display a "SYSTEM IS NORMAL" message and the current time and date.
- D. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.
- E. The LCD shall display the following information relative to the abnormal condition of a point in the system:
  - 1. 40 character custom location label.
  - 2. Type of device (e.g., smoke, pull station, waterflow).
  - 3. Point status (e.g., alarm, trouble).
- F. Operator keys shall be key switch enabled to prevent unauthorized use. The key shall only be removable in the disabled position. Acknowledge, Silence and Reset operation shall be the same as the FACP.

## 2.5 REMOTE QVGA LCD ANNUNCIATOR

- A. Provide a remote QVGA LCD Annunciator, where required, with the same "look and feel" as the FACP operator interface. The Remote QVGA LCD Annunciator shall use the same Primary Acknowledge, Silence, and Reset Keys as the FACP.
- B. The QVGA Annunciator shall have an expanded content, multi-line display capable of supporting a minimum of 854 standard ASCII characters to minimize or eliminate the levels of navigation required for access to information when responding to critical emergencies and abnormal system conditions. The QVGA Annunciator shall provide:
  - 1. Operator prompts and six context sensitive soft-keys for intuitive operation.
  - 2. Seven (7) programmable control switches and associated LEDs.
  - 3. Three (3) programmable general purpose LEDs.
  - 4. Capability of supporting Dual Languages with Instant-Switchover between languages in runtime operation.
  - 5. Support for both one-byte and two-byte characters.
- C. The QVGA Annunciator shall be programmable for the following Activity display choices:
  - 1. First 8 Events.
  - 2. First 5 Events and Most Recent Event with First and Most Recent event time and date stamps.
  - 3. First Event and Most Recent Event with First and Most Recent event time and date stamps.
  - 4. Scrollable List Display displays a scrollable list of active points for the event category (alarm, priority 2, supervisory, or trouble) selected. The position in this list will be the last acknowledged point (not flashing) at the top followed by the next 7 unacknowledged points



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(flashing).

5. General Event Status (Alarm, Priority 2, Supervisory, or Trouble in system).
  6. Site Plan with optional status icons to indicate area status for highest priority active events.
- D. Should an abnormal condition be detected the appropriate LED (Alarm, Priority 2, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.
- E. The QVGA LCD shall display the following minimum information relative to the abnormal condition of a point in the system:
1. 40 character custom location label.
  2. Type of device (e.g., smoke, pull station, waterflow).
  3. Point status (e.g., alarm, trouble).
- F. QVGA Annunciators shall be protected from unauthorized use via a locked door or equivalent means. In addition, in systems with two or more Annunciators, each Annunciator shall be programmable to allow multiple Annunciators to have equal operation priority or to allow hierarchical priority control to be assigned to individual Annunciators (locations). Acknowledge, Silence and Reset operation shall be the same as the FACP.

## 2.6 GRAPHIC ANNUNCIATOR

- A. Framed, color map of the building with each floor shown plus the final room names and numbers that match the fire alarm programming. Minimum size: 24"x36".

## 2.7 DACT/IP/CELLULAR COMMUNICATOR TRANSMITTER

- A. DACT/IP/Cellular communicator transmitter shall be listed to UL 864 for Central Station Service and be acceptable for use by the remote or central station.
- B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for, or connected via TCP/IP or Cellular to a remote or central station. When contact is made with the remote or central station, signals shall be transmitted. If connecting by POTS and service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the remote or central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal. If service is by TCP/IP or Cellular and connection is lost, transmitter shall initiate the local trouble signal and a loss of connection shall be indicated at the central station.
- C. Local functions of the DACT/IP/Cellular communicator transmitter shall include the following:
1. Configurable with a primary and secondary path.
  2. Paths can use any of the external connections, telephone line, cellular, or LAN Ethernet connections.
  3. 3G with 2G fall back cellular connection through the cellular module. Antenna extension kits for areas of poor connectivity.

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4. Communications failure with the remote or central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address or loss of power.
4. Low battery.
5. Abnormal test signal.
6. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Constant connection supervision and detects failures within 90 seconds for IP/Cellular connection.

2.8 EMERGENCY POWER SUPPLY

A. General: Components include battery, charger, and an automatic transfer switch.

- B. Battery: Sealed lead-acid or nickel cadmium type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm notification devices in alarm mode for a period of 15 minutes.

2.9 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by manufacturer of device.
2. Finish: Paint of color to match the protected device.

2.10 MISCELLANEOUS MONITORING

- A. Provide addressable monitoring control module and wiring to the central mechanical DDC control system. This module shall provide a contact closure in the event of an alarm condition, which will provide cause the DDC system to shut-down the HVAC system. Contractor is required to contract with TRI-M Controls to provide the contact interface and programming for the mechanical DDC system.

PART 3 – EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install system components and all associated devices in accordance with applicable NFPA Standards and manufacturer's recommendations.
- B. Installation personnel shall be supervised by persons who are qualified and experienced in the

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installation, inspection, and testing of fire alarm systems. Examples of qualified personnel shall include, but not be limited to, the following:

1. Factory trained and certified personnel.
2. National Institute of Certification in Engineering Technologies (NICET) fire alarm level II certified personnel.
3. Personnel licensed or certified by state or local authority.

### 3.2 EQUIPMENT INSTALLATION

- A. Furnish and install a complete Fire Alarm System as described herein and as shown on the plans. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes, and all other necessary material for a complete operating system.
- B. System Retrofits shall require that Existing Fire Alarm Equipment shall be maintained fully operational until the new equipment has been tested and accepted.
- C. Equipment Removal: After acceptance of the new fire alarm system, disconnect and remove the existing fire alarm equipment and restore damaged surfaces. Package operational fire alarm and detection equipment that has been removed and deliver to the Owner. Remove from the site and legally dispose of the remainder of the existing material.
- D. Water-Flow and Valve Supervisory Switches: Connect for each sprinkler valve required to be supervised.
- E. Device Location-Indicating Lights: Locate in the public space immediately adjacent to the device they monitor.
- F. Label all fire alarm devices with the initiation circuit and device number as well as the notification circuit and device number. All labeling shall exactly match the as-built shop drawings, which shall be submitted with the O&M manuals.

### 3.3 WIRING INSTALLATION

- A. System Wiring: Wire and cable shall be MC cable type FPLP and shall be acceptable to the Authority Having Jurisdiction (AH) and shall be installed in accordance with the appropriate articles from the current approved edition of NFPA 70: National Electric Code (NEC). Refer to Division 26 Section "Conductors and Cables" for acceptable locations for type MC cable vs. individual conductors in raceway – provide fire alarm wiring in conduit in Boiler Rooms, Transformer Rooms/Vaults, Electrical Rooms, spaces with exposed ceilings and the like.
  1. Standard FPLP or FPLR cabling shall not be used. See MC cable FPLP requirements above.
- B. Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable sizes and types (shielded and non-shielded) to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.
- C. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Paint fire alarm system junction boxes and covers red.

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### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.
- B. Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:
  - 1. Factory trained and certified.
  - 2. National Institute for Certification in Engineering Technologies (NICET) fire alarm certified.
  - 3. International Municipal Signal Association (IMSA) fire alarm certified.
  - 4. Certified by a state or local authority.
  - 5. Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.
- C. Pretesting: Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.
- D. Final Test Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance testing.
- E. Minimum System Tests: Test the system according to the procedures outlined in NFPA 72.
- F. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.
- G. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log.
- H. Final Test, Certificate of Completion, and Certificate of Occupancy:
  - 1. Test the system as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy.

### 3.5 CLEANING AND ADJUSTING

- A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Clean unit internally using methods and materials recommended by manufacturer.
- B. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

### 3.6 TRAINING

- A. Provide the services of a factory-authorized service representative to demonstrate the system and

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train Owner's maintenance personnel as specified below.

1. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 4 hours' training.
2. Schedule training with the Owner at least seven days in advance.

END OF SECTION

## SECTION 311000

### SITE CLEARING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Temporary erosion and sedimentation control.

##### 1.2 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. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.
- 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 as shown on Drawings.
- E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

##### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site

##### 1.4 MATERIAL OWNERSHIP

- A. Cleared materials in access shall become Contractor's property and shall be removed from Project site.

## 1.5 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. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.
- B. Topsoil stripping and stockpiling program.
- C. Rock stockpiling program.
- D. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

## 1.6 QUALITY ASSURANCE

- A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.
- B. Rock Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

## 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. Construction entrances to be installed per plans. Contractor will not deviate from entrances as shown.
- B. Utility Locator Service: Notify utility locator service and Pennsylvania One Call for area where Project is located before site clearing. Contractor to be responsible to have all utilities marked by utility locator before site clearing. Utility mark-outs to remain visible throughout construction.
- C. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.

- D. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified on the plans.
  - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

## 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 and that protection zones have been identified and enclosed according to the approved Erosion and Sedimentation Plans.
- 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 EROSION AND SEDIMENTATION CONTROL

- A. Provide 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.

### 3.3 TREE AND PLANT PROTECTION

- A. Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."



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- 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 on the plans to be removed
  - 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 as shown on the plans.

### 3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
  - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
  - 2. Grind down stumps and remove all roots below exposed subgrade.
  - 3. Use only hand methods or air spade for grubbing within protection zones.
  - 4. Chip removed tree branches and dispose of off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

### 3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.
  - 1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than one inch in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
  - 1. Limit height of topsoil stockpiles to one half the width of disturbance.
  - 2. Do not stockpile topsoil within protection zones.
  - 3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
  - 4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

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### 3.7 STOCKPILING ROCK

- A. Stockpile rock away from edge of excavations without intermixing with other materials. Cover to prevent windblown debris from accumulating among rocks.
  - 1. Dispose of surplus rock. Surplus rock is that which exceeds quantity indicated to be stockpiled or reused.

### 3.8 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, 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. 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.

### 3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Burning tree, shrub, and other vegetation waste is not permitted.
- C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

## SECTION 312000 - EARTH MOVING

### 1.1 SUMMARY

#### A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses.
3. Drainage course for concrete slabs-on-grade.
4. Subbase course for concrete walks and pavements.
5. Subbase course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

### 1.2 UNIT PRICES

- A. Work of this Section is affected by unit prices for earth moving specified in previous sections. Base price is to include 100 cubic yards of rock removal. Unit Prices for Rock Excavation over 100 cubic yards is to be provided as described in previous sections.
- B. Quantity allowances for earth moving are included in previous sections.
- C. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following. Unit prices for rock excavation include replacement with approved materials.
  1. 24 inches outside of concrete forms other than at footings.
  2. Outside dimensions of concrete walls indicated to be cast against rock without forms as approved by project geotechnical engineer.
  3. 6 inches beneath pipe in trenches including underground storm basins and the greater of 12 inches wider than pipe

### 1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
  1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
  2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

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- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
  - 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices
  - 2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
  - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock Excavation for Trenches and Pits: Removal and disposal of materials and obstructions encountered that cannot be excavated with a track-mounted power excavator, equivalent to Caterpillar Model NO. 325B, 168 HP, 48,350 lb. drawbar pull and 36 inch bucket rated at 1.0 cubic yard capacity. Trenches in excess of 10 feet in width and pits in excess of 30 feet in either length or width are classified as bulk excavation.
- I. Rock Excavation in Bulk Excavation: Removal and disposal of materials and obstructions encountered that cannot be dislodged and excavated with modern, track-mounted, heavy-duty excavating equipment. Heavy-duty excavating equipment is considered equal to Caterpillar Model No. D-8 Ripper Tractor or equivalent track-mounted loader, rated at not less than 84,850 pounds operating weight, 310 HP rated power and developing minimum of 50,070-pound bucket breakout force (measured in accordance with SAE J732). Excavation which can be accomplished with this equipment or equivalent is considered as Earth Excavation.
- J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- K. 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.
- L. 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.
- M. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct preexcavation conference at project site.

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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. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
  - d. Extent of trenching by hand or with air spade.
  - e. Field quality control.
  - f. Time restrictions dictated by hours of operation for the School.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Controlled low-strength material, including design mixture.
3. Warning tapes.

- B. Samples for Verification: For the following products, in sizes indicated below:

1. Geotextile: 12 by 12 inches
2. Warning Tape: 12 inches long; of each color.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.

- B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D2487.
2. Laboratory compaction curve according to ASTM D698.

- C. Preexcavation 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.

- D. PADEP Clean Fill and Regulated Fill Standards: Show that excavation material leaving the Site meet standards as determined by the Pennsylvania Department of Environmental Protection Standards.

- E. NPDES: Show excavation material placed off-Site is in an area regulated by a current NPDES permit as issued by a County Conservation District and Pennsylvania Department of Environmental Protection.

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## 1.7 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

## 1.8 FIELD CONDITIONS

- A. Traffic: No motor vehicle is permitted to access or leave the Project site between the hours of 7:30 am and 8:30am while school is in session. No motor vehicle is permitted to access or leave the Project site between the hours of 3:00 pm and 4:00 pm while school is in session. Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
  - 1. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Utility Locator Service: Notify utility locator service and Pennsylvania "One Call" for all areas where Project is located before beginning earth-moving operations.
- C. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified on the drawings are in place.
- D. Do not commence earth-moving operations until plant-protection measures specified on the plans are in place.
- E. The following practices are prohibited within protection zones:
  - 1. Storage of construction materials, debris, or excavated material.
  - 2. 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.
- F. Do not direct vehicle or equipment exhaust towards protection zones.
- G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

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- B. Satisfactory Soils: Soil Classification according to AASHTO M 145, or as approved by the Project Geotechnical Engineer free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification according to AASHTO M 145, or as determined by the Project Geotechnical Engineer.
  - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. 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.
- E. 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.
- F. Engineered Fill: 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.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Drainage Course: Narrowly graded mixture of clean crushed stone ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.
- I. Sand: ASTM C33/C33M; fine aggregate.

## 2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
  - 1. Survivability: Class 2; AASHTO M 288.
  - 2. Survivability: As follows:
    - a. Grab Tensile Strength: 157 lbf; ASTM D4632.
    - b. Sewn Seam Strength: 142 lbf; ASTM D4632.
    - c. Tear Strength: 56 lbf; ASTM D4533.
    - d. Puncture Strength: 56 lbf; ASTM D4833.
  - 3. Apparent Opening Size: **No. 60** sieve, maximum; ASTM D4751.

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- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
  - 1. Survivability: Class 2; AASHTO M 288.
  - 2. Survivability: As follows:
    - a. Grab Tensile Strength: 247 lbf ; ASTM D4632.
    - b. Sewn Seam Strength: 222 lbf ; ASTM D4632.
    - c. Tear Strength: 90 lbf ; ASTM D4533.
    - d. Puncture Strength: 90 lbf ; ASTM D4833.
  - 3. Apparent Opening Size: No. 60 sieve, maximum; ASTM D4751.
  - 4. Permittivity: 0.02 per second, minimum; ASTM D4491.
  - 5. UV Stability: 50 percent after 500 hours' exposure; ASTM D4355.

## 2.3 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.
- D. Perform testing that might be required to assure excavation material that leaves the Project site meets the PADEP Clean Fill and Regulated Fill Standards.



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### 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: Not Permitted.

### 3.4 EXCAVATION, GENERAL

- A. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Architect. The Contract Sum will be adjusted for rock excavation over 100 cubic yards according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.
  - 1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; and soil, boulders, and other materials not classified as rock or unauthorized excavation.
    - a. Intermittent drilling; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
  - 2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:
    - a. 24 inches outside of concrete forms other than at footings.
    - b. 12 inches outside of concrete forms at footings unless otherwise reviewed and approved by Project geotechnical engineer.
    - c. Outside dimensions of concrete walls indicated to be cast against rock without forms as approved by Project geotechnical engineer.

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- d. 6 inches beneath pipe in trenches including underground detention basins and the greater of 12 inches wider than pipe.

### 3.5 EXCAVATION FOR STRUCTURES OTHER THAN BUILDING

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
  1. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
  1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

### 3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

### 3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
  1. Beyond building perimeter, excavate trenches to allow installation of pipe in accordance with the plans..
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
  1. Clearance: 12 inches each side of pipe or conduit if not otherwise indicated on the plans.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
  1. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
  2. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

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D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.8 SUBGRADE INSPECTION

- A. Notify Architect when excavations have reached required subgrade.
- B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-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 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 Architect, and replace with compacted backfill or fill as directed by Project geotechnical engineer.
- D. Authorized additional excavation rock over 100 cubic yards 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 Architect, without additional compensation.

3.9 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
  1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.

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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.

### 3.11 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Backfill voids with satisfactory soil while removing shoring and bracing.
- D. Initial Backfill:
1. Soil Backfill: Place and compact initial backfill of subbase material or satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
    - a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- E. Final Backfill:
1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
  2. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
- F. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

### 3.12 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
1. Under grass and planted areas, use satisfactory soil material.
  2. Under walks and pavements, use satisfactory soil material.

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3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

### 3.13 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
  2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

### 3.14 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 D1557:
1. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
  2. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 90 percent.
  3. For utility trenches, compact each layer of initial and final backfill soil material at 90 percent.
  4. For concrete pads and pavement for athletic equipment, final backfill soil material at 90 percent.

### 3.15 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
1. Provide a smooth transition between adjacent existing grades and new grades.
  2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

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- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch
2. Walks: Plus or minus 1/8 inch.
3. Pavements: Plus or minus 1/2 inch.

### 3.16 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
  1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends if required per the plans.
  2. For asphalt paving, place base course material over subbase course under hot-mix asphalt pavement.
  3. Shape subbase course and base course to required crown elevations and cross-slope grades.
  4. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
  5. Place subbase course and base 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.
  6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D698.

### 3.17 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.
  4. The amount of rock excavated
- B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

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- 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 1000 sq. ft. or less of paved area or building slab but in no case fewer than three tests.
  - 2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 100 feet or less of trench length but no fewer than two 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.
- F. Owner will provide licensed surveyor to verify utilities are installed to proper slope as indicated on the plans. After installation of utility in a trench, backfill of the trench will not occur until surveyor has confirmed elevations. Compensation will not be issued to correct installation.

### 3.18 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 Architect; 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.

### 3.19 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.
- B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

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1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000



## **SECTION 31 20 13 – EARTHWORK WITHIN PERIMETER OF BUILDING FOOTPRINT**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Preparing subgrades for slabs-on-grade.
  - 2. Excavating and backfilling for buildings and structures.
  - 3. Drainage course for slabs-on-grade.
  - 4. Subsurface drainage backfill for walls and trenches.
  - 5. Excavating and backfilling trenches within building lines.
- B. Related Sections include the following:
  - 1. Division 01 Section "Temporary Facilities and Controls."

#### **1.3 DEFINITIONS**

- A. Backfill: Soil materials used to fill an excavation.
  - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
  - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.
- C. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- D. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.
- E. Excavation: Removal of material encountered above subgrade elevations.
  - 1. Additional Excavation: Excavation below subgrade elevations as directed by Architect. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
  - 2. Bulk Excavation: Excavations more than 10 feet in width and pits more than 30 feet in either length or width.

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3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

F. Fill: Soil materials used to raise existing grades.

G. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material exceeding 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- wide, short-tip-radius rock bucket; rated at not less than 120-hp flywheel power with bucket-curling force of not less than 25,000 lbf and stick-crowd force of not less than 18,700 lbf; measured according to SAE J-1179.
2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp flywheel power and developing a minimum of 45,000-lbf breakout force; measured according to SAE J-732.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

J. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

#### 1.4 SUBMITTALS

A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D 698 for each on-site or borrow soil material proposed for fill and backfill.
3. Laboratory compaction curve according to ASTM D 1557 for each on-site or borrow soil material proposed for fill and backfill.

#### 1.5 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

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## 1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Owner's written permission.
  - 3. Contact utility-locator service for area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D 2487 soil classification groups GW, GP, GM, GC, SW, SP, SC, ML, CL, and SM, or a combination of these group symbols; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: ASTM D 2487 soil classification groups MH, CH, OL, OH, and PT, or a combination of these group symbols.
  - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Structural Fill: Naturally or artificially well graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; with not more than 20 percent passing a No. 200 sieve and a plasticity index not greater than 8 percent. Maximum particle size of 3 inches.
- E. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- F. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2- inch sieve and 0 to 5 percent passing a No. 8 sieve.
- G. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.

### **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 earthwork operations.
- B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.
- C. Provide 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.
- D. All vegetation, rootmat, topsoil, unsuitable existing fill, asphalt, and other soft or unsuitable materials within 5 feet of the foundation edges is to be removed.

#### **3.2 DEWATERING**

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. 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.
  - 2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

#### **3.3 EXPLOSIVES**

- A. Explosives: Blasting is not permitted on the project.

#### **3.4 EXCAVATION, GENERAL**

- A. Unclassified Excavation: 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.
  - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
  - 2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:

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- a. 24 inches outside of concrete forms other than at footings.
- b. 12 inches outside of concrete forms at footings.
- c. 6 inches outside of minimum required dimensions of concrete cast against grade.
- d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
- e. 6 inches beneath bottom of concrete slabs-on-grade.
- f. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

### 3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
  - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

### 3.6 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
  - 1. Clearance: 12 inches on each side of pipe or conduit.
- C. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.
  - 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

### 3.7 APPROVAL OF SUBGRADE

- A. Notify Geotechnical Engineer when excavations have reached required subgrade.
- B. If Geotechnical Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
  - 1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- C. Proof roll subgrade in the presence of the Owner's Geotechnical engineer using a loaded dump truck or a minimum 10-ton vibratory roller. Do not proof roll wet or saturated subgrades.

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- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Geotechnical Engineer.

### 3.8 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 may be used when approved by Architect.
  - 1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

### 3.9 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

### 3.10 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
  - 1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
  - 2. Surveying locations of underground utilities for record documents.
  - 3. Inspecting and testing underground utilities.
  - 4. Removing concrete formwork.
  - 5. Removing trash and debris.
  - 6. Removing temporary shoring and bracing, and sheeting.
  - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

### 3.11 UTILITY TRENCH BACKFILL

- A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- B. Backfill trenches excavated under footings and within 18 inches of bottom of footings; fill with concrete to elevation of bottom of footings.
- C. Coordinate backfilling with utilities testing.

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- D. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.
- E. Place and compact final backfill of satisfactory soil material to final subgrade.
- F. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under slabs.

### 3.12 FILL

- A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.
- B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- C. Place and compact fill material in layers to required elevations as follows:
  - 1. Under building slabs, use satisfactory or structural fill.
  - 2. Under footings and foundations, use satisfactory or structural fill.

### 3.13 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
  - 1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
  - 2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

### 3.14 COMPACTION OF BACKFILLS AND FILLS

- A. Place backfill and fill materials in layers not more than 8 to 10 inches in loose depth for fine grained fill and 10 to 12 inches in loose depth for granular fill.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. When heavy duty construction equipment is used, compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D1557:
  - 1. Under foundations, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill material at 95 percent. Under slabs-on-grade, compact fills to 93 percent.

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- D. When small, hand operated compaction equipment is used, compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
  - 1. Under foundations, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill material at 98 percent. Under slabs-on-grade, compact fills to 95 percent.

### 3.15 GRADING

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
  - 1. Provide a smooth transition between adjacent existing grades and new grades.
  - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

### 3.16 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
  - 1. Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
  - 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 100 feet or less of wall length, but no fewer than two tests.
  - 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench length, but no fewer than two tests.



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- 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 to depth required; recompact and retest until specified compaction is obtained.

### 3.17 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 Architect; 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 the greatest extent possible.

### 3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

**END OF SECTION 31 20 13**

SECTION 312100

EROSION AND SEDIMENT CONTROL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION

- A. This work shall consist of temporary measures to control erosion and sediment during the life of the contract, as shown on the Plans and as approved by the Engineer.
- B. The temporary control provisions contained herein shall be coordinated with the permanent improvements (grass, pavement and other restorations) specified elsewhere in the contract to the extent practical to assure effective and continuous erosion and sediment control throughout the construction and post-construction period.
- C. The erosion and sediment control measures described herein shall be continued until the construction is complete and final restorations installed.

1.3 MATERIALS

- A. All materials and methods of construction shall be in accordance with the Pennsylvania Standards for Soil Erosion and Sediment Control.

1.4 METHODS OF CONSTRUCTION

- A. Contractor shall comply with the construction requirements shown on the plan entitled, "E & S Control Details."
- B. Contractor shall adhere, as closely at practicable, to the construction sequence provided on the plan entitled, "E & S Control Details".
- C. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other federal or state or location agencies, the more restrictive laws, rules or regulations shall apply.
- D. The Contractor will be responsible for maintaining all soil erosion and sediment control measures as specified on the Plans. All temporary measures shall be removed by the Contractor as approved by the Engineer.
- E. In case of repeated failures on the part of the Contractor to control erosion, pollution, and/or siltation, the Owner reserves the right to employ outside assistance or to use his own forces to provide the necessary corrective measures. Further, the Soils Conservation District Office may order the Contractor to cease operations until all soil erosion and sediment control measures are

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satisfactory. Such incurred costs of remediation and time delays will be charged to the Contractor, with no additional costs to the Owner.

END OF SECTION

## SECTION 312319

### 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**] <Insert location>.
  - 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. Field quality-control reports.
- B. 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.
- C. Record Drawings: Identify locations and depths of capped wells and well points and other abandoned-in-place dewatering equipment.

## 1.6 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.

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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, which are specified on the plans

#### 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.

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- 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.
- 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.

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- 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 312319



SECTION 321216

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. Pennsylvania DOT Publication 408

1.2 SUMMARY

- A. Section Includes:
  - 1. Hot-mix asphalt paving.
  - 2. Asphalt surface treatments.

1.3 DEFINITION

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
  - 1. Job-Mix Designs: For each job mix proposed for the Work.
- B. Material Certificates: For each paving material, from manufacturer.
- C. Material Test Reports: For each paving material.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.
- B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of PADOT.
- C. Pre-installation Conference: Conduct conference at Project site.

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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 condition of subgrade and preparatory work.
  - c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
  - d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

## 1.6 PROJECT 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. Tack Coat: Minimum surface temperature of 60 deg F.
  2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
  3. 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 D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
- C. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
- D. Sub-base: Crushed 2A Stone in accordance with PA DOT Publication 408.

### 2.2 ASPHALT MATERIALS

- A. Asphalt Binder: AASHTO M 320, of required performance grade.
- B. Asphalt Cement: ASTM D 3381 for viscosity-graded material.
- C. Tack Coat: ASTM D 977 emulsified asphalt, of suitable grade and consistency for application.

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- D. Water: Potable.

## 2.3 AUXILIARY MATERIALS

- A. Joint Sealant: ASTM D 6690, Type I, hot-applied, single-component, polymer-modified bituminous sealant.

## 2.4 MIXES

- A. Hot-Mix Asphalt: Provide pavement depths as indicated on the plans. Asphalt mix to be in accordance with PA DOT 408.
  - 1. Contractor to submit asphalt mix and certification of mix produced at a PA DOT Approved Plant.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- 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, Limit vehicle speed to 3 mph.
  - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Owner, and replace with compacted backfill or fill as directed.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.
- D. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

### 3.2 PATCHING

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into 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: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving 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.

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2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- C. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.
- D. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

### 3.3 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.
- 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.

### 3.4 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- 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.

### 3.5 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to 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. Spread mix at minimum temperature of 250 deg F.
  3. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
  4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

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- B. 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.

### 3.6 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. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
  - 5. Compact asphalt at joints to a density within 2 percent of specified course density.

### 3.7 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. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- C. 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.
- D. 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.
- E. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- F. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### 3.8 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
  - 1. Base Course: Plus or minus 1/2 inch.

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2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a 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.

### 3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner to engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.

1. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
  - a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
  - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

E. Replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

### 3.10 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

END OF SECTION

SECTION 321252

STONE SUBBASE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Installation of stone subbase prior to placement of proposed bituminous pavement or concrete walks/pads.

PART 2 PRODUCTS

2.1 MATERIAL STANDARDS

- A. Sound crushed stone or gravel complying with PaDOT specification for type 2A stone.

PART 3 EXECUTION

3.1 GENERAL

- A. All construction shall be in accordance with PaDOT Publication 408, Section 350, latest edition.

3.2 PREPARATION OF STONE SUBBASE

- A. Install subbase materials to achieve the proposed top of stone subbase elevations and minimum compacted thicknesses as shown on the Contract Drawings and as specified herein.
- B. Thoroughly compact the stone surface with a power roller weighing not less than ten (10) tons, or by a vibratory roller, until the surface is satisfactorily stable as determined by the Engineer. Compact base to 100 percent of ASTM D 1557 maximum laboratory dry density. Compaction shall be determined to be satisfactory when visual inspection by the Engineer reveals no movement of the material under compaction equipment.
- C. The Contractor is responsible for obtaining satisfactory stability of the subbase.

3.3 UTILITY ADJUSTMENTS

- A. The Contractor shall be responsible for contacting Owners of other utilities to make arrangement for adjustments as necessary.

3.4 PROTECTION

- A. The Contractor shall not haul heavy loads over the completed base course. Rutting or displacement of base course aggregate by traffic or the movement of heavy equipment or

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other damage caused by the Contractor shall be repaired at his expense.

END OF SECTION 321252



SECTION 321313

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. This Section includes exterior cement concrete pavement for the following:
  - 1. Sidewalks.
  - 2. Driveways
  - 3. Site Flat Concrete.
- B. Related Sections include the following:
  - 1. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants of joints in concrete pavement and at isolation joints of concrete pavement with adjacent construction.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
- D. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:
  - 1. Cementitious materials.
  - 2. Steel reinforcement and reinforcement accessories.
  - 3. Admixtures.

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4. Bonding agent or epoxy adhesive.

E. Field quality-control test reports.

F. Minutes of pre-installation conference.

## 1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who 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."

B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.

C. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.

D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1. Before submitting design mixtures, review concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and concrete pavement construction practices.

## 1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

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1. Products: Subject to compliance with requirements, provide one of the products specified.
2. 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.

## 2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
  1. Use flexible or curved forms for curves with a radius 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 will not impair subsequent treatments of concrete surfaces.

## 2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- B. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.
- C. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60; Cut bars true to length with ends square and free of burrs.

## 2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout the Project:
  1. Portland Cement: ASTM C 150, Type I. Supplement with the following:
    - a. Fly Ash: ASTM C 618, Class F.
    - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate, uniformly graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar pavement applications and service conditions using similar aggregates and cementitious materials.
  1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.
  2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

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- C. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:
  - 1. Aggregate Sizes: 3/4 to 1 inch nominal.
- D. Water: ASTM C 94/C 94M.
- E. Air-Entraining Admixture: ASTM C 260.
- F. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

## 2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- 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.

## 2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: [ASTM D 1751, asphalt-saturated cellulosic fiber.
- B. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to requirements, and as follows:

## 2.7 PAVEMENT MARKINGS

- A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type: as required.

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1. Color: As indicated.

## 2.8 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
  1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
  1. Compressive Strength (28 Days): 4500 psi.
  2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.60.
  3. Slump Limit: 4 inches, plus or minus 1 inch.
- 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: 6 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.
- D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
- E. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements as follows:
  1. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
- F. 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 deg F 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 pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.

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1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.
2. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction.

- C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

### 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 for pavement 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

- 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.

### 3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edgings 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 pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.

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1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
  2. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. 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 pavement:
1. 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.
  2. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.
- D. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

### 3.6 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and 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.
- F. Do not add water to fresh concrete after testing.
- G. 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.
- H. 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.

- I. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.
  - 1. Remove and replace concrete that has been placed for more than 15 minutes without being covered by top layer, or use bonding agent if approved by Architect.
- J. Screed pavement surfaces with a straightedge and strike off.
- K. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- L. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.
  - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.
- M. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.
- N. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 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 mix designs.
- O. Hot-Weather 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 to 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.



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### 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 bleed-water 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 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. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
  - 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, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during 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.

### 3.9 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:

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1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot-long, unlevelled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

### 3.10 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow concrete pavement to cure for 28 days and be dry before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

### 3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
  1. Testing Frequency: Obtain at least 1 composite sample for each **100 cu. yd.** or fraction thereof of each concrete mix 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 mix. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
  4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.

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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 1 specimen at 7 days and 2 specimens at 28 days.

A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

- C. Strength of each concrete mix will be satisfactory if average of any 3 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. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.12 REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

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END OF SECTION

SECTION 321373

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.
- B. Related Sections include the following:
  - 1. Section 321313 "Concrete Paving" for exterior cement concrete paving and curbs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of joint sealant and accessory.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.

1.6 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:

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1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
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.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- 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 JOINT SEALANTS

- A. Multicomponent, Nonsag, Urethane, Elastomeric Polyurethane Joint Sealant: ASTM C 920, Type M, Grade P, Class 25, for Use T.
  1. Color: Standard grey or tan color to match concrete. Submit full range of standard colors for selection by Owner and Engineer.

### 2.3 JOINT-SEALANT BACKER MATERIALS

- A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.
- B. Backer Strips for Cold-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

### 2.4 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine joints 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: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on 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.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions.
- C. Install joint-sealant backings 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.
- D. Install joint sealants immediately following backing installation, using proven techniques that comply with the following:
  - 1. Place joint sealants so they fully contact joint substrates.
  - 2. Completely fill recesses in each joint configuration.

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3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- 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.
- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

#### 3.4 CLEANING AND PROTECTION

- A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.
- B. 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 and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

END OF SECTION 321373



SECTION 321723

PAVEMENT MARKINGS

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 painted markings applied to asphalt pavement.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site
  - 1. Review methods and procedures related to marking pavement including, but not limited to, the following:
    - a. Pavement aging period before application of pavement markings.
    - b. Review requirements for protecting pavement markings, including restriction of traffic during installation period.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include technical data and tested physical and performance properties.
- B. Shop Drawings: For pavement markings.
  - 1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.
  - 2. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.
- C. Samples: For each exposed product and for each color and texture specified; on rigid backing, 8 inches square.

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## 1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of PADOT for pavement-marking work.
  - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

## 1.6 FIELD CONDITIONS

- A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F for water-based materials, and not exceeding 95 deg F.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in ADA Standards for Accessible Design and ICC A117.1

### 2.2 PAVEMENT-MARKING PAINT

- A. Pavement-Marking Paint, Parking Lots: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248.
  - 1. Color: As indicated
- B. Glass Beads, for cross walks : AASHTO M 247, Type 1 made of 100 percent recycled glass.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.
- B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

### 3.2 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

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- B. Allow paving to age for a minimum of 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils
  - 1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.
  - 2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb/gal.

### 3.3 PROTECTING AND CLEANING

- A. Protect pavement markings from damage and wear during remainder of construction period.
- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 321723

SECTION 321813

SYNTHETIC GRASS SURFACING

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 synthetic grass surfacing.
- B. Related Requirements:
  - 1. Section 312000 "Earth Moving" for preparation, compaction, and grading of granular base.

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. Shop Drawings: For synthetic grass surfacing.
  - 1. Include sections and details.
  - 2. Show locations of seams and method of seaming.
- C. Samples: For each type of synthetic grass surfacing indicated.
  - 1. Turf Fabric: 12 inches square.
  - 2. Infill Material: 4 oz. of each type.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each synthetic grass surfacing assembly.

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- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For synthetic grass surfacing, including maintenance cleaning instructions, 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.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials in location and manner to allow installation of synthetic grass surfacing without excess disturbance of granular base.

#### 1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace synthetic grass surfacing that fails in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration and excessive wear.
    - b. Deterioration from UV light.
    - c. Excessive loss of shock attenuation.
    - d. Seam separation, including game lines and markings.
  - 2. Warranty Period: 10 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 SYNTHETIC GRASS SURFACING

- A. Turf Fabric:
  - 1. AstroTurf Rootzone 3D3 Blend 2inch 52oz.
    - a. With inlaid sports lines/number/letters. Color selected by owner.
- B. Infill:

1. Base Design: EPDM rubber infill and sand.
  2. Option 1: BrockFill organic infill, Brock power base YZR pad
  3. Option 2: Recycled crumb rubber infill and sand
- C. Seaming Method: Per manufacturer.

## 2.2 MATERIALS

- A. Rubber Infill: To be free of metal, nonmetal fibers, and contaminants; mesh size as recommended by synthetic grass surfacing manufacturer.
- B. BrockFill: To be free of metal, nonmetal fibers, and contaminants; mesh size as recommended by synthetic grass surfacing manufacturer.
- C. Sand Infill: Uniformly sized silica sand free of silts, clays, and contaminants, and of subangular or rounder shape according to ASTM F1632; mesh size as recommended by synthetic grass surfacing manufacturer.
- D. Seam Adhesive: One- or two-part urethane, recommended or approved by synthetic grass surfacing manufacturer, and suitable for ambient conditions at time of installation.
- E. Seaming Cord: Seaming cord or thread, recommended by the synthetic grass surfacing manufacturer.
- F. Pad: Brock power base YZR pad.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine base and other conditions, with Installer present, for compliance with requirements for installation tolerances, permeability, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Avoid disturbance of base during installation of turf fabric.
- B. Roll out turf fabric and allow to relax at least four hours prior to seaming.
- C. Provide seams flat and snug, with no gaps or fraying. Remove yarns that are trapped within seams. Attach turf fabric to perimeter restraint system as recommended by the manufacturer.

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- D. Install around fixed equipment per manufacturer's instructions.
- E. Repair loose seams and bubbles formed due to expansion of turf fabric prior to installation of infill.
- F. Evenly broadcast and groom infill by machine in proportions and depth after settling as recommended by the manufacturer. Rake fibers trapped by infill to surface.

### 3.3 DEMONSTRATION

- A. Train Owner's maintenance personnel in proper maintenance procedures for synthetic grass surfacing.

END OF SECTION 321813

SECTION 323223

SEGMENTAL RETAINING 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. This Section includes multiple depth segmental retaining walls with and without soil reinforcement.
- B. Related Requirements:
  - 1. Section 312000 "Earth Moving" for excavation for segmental retaining walls.

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. Design Submittals:
  - 1. Shop drawings signed and sealed by a licensed engineer in the State of Pennsylvania to be submitted to the Architect for each Project wall.
  - 2. Shop drawing showing proposed wall reinforcing and interaction with adjacent site elements such as privacy fencing and guiderails.
- C. Samples: For each color and texture of concrete unit specified. Submit sections of units not less than 3 inches square.
- D. Delegated-Design Submittal: For segmental retaining walls.



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## 1.5 SHOP DRAWINGS

- A. Qualification Data: For testing agency.
- B. Product Certificates: For each type of segmental retaining wall unit **and soil reinforcement**] from manufacturer.
  - 1. Include test data for shear strength between segmental retaining wall units according to ASTM D6916.
  - 2. Include test data for connection strength between segmental retaining wall units and soil reinforcement according to ASTM D6638.
- C. Research/Evaluation Reports: For segmental retaining wall units and soil reinforcement, from ICC-ES.
- D. Preconstruction test reports.
- E. Source quality-control reports.
- F. Field quality-control reports.

## 1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform the following preconstruction testing:
  - 1. Test soil reinforcement and backfill materials for pullout resistance according to ASTM D6706.
  - 2. Test soil reinforcement and backfill materials for coefficient of friction according to ASTM D5321.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle concrete units and accessories to prevent deterioration or damage due to contaminants, breaking, chipping, or other causes.
- B. Store geosynthetics in manufacturer's original packaging with labels intact. Store and handle geosynthetics to prevent deterioration or damage due to sunlight, chemicals, flames, temperatures and other conditions that might damage them. Verify identification of geosynthetics before use, and examine them for defects as material is placed.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer to design segmental retaining walls.

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- B. Compliance Review: Qualified professional engineer responsible for segmental retaining wall design shall review and approve submittals and source and field quality-control reports for compliance of materials and construction with design.
- C. Structural Performance: Engineering design shall be based on determined loads and be according
  - 1. Gravity loads due to soil pressures resulting from grades indicated.
  - 2. Superimposed loads (surcharge) for proposed use.
  - 3. Horizontal Peak Ground Acceleration (A) for Project:

## 2.2 SEGMENTAL RETAINING WALL UNITS

- A. Concrete Units: ASTM C1372, Normal Weight, except units shall not differ in height more than plus or minus 1/16 inch from specified dimension.
  - 1. Provide units that comply with requirements in ASTM C1372 for freeze-thaw durability.

Provide units that interlock with courses above and below.

- B. Color: Present color pallet to architect with shop drawings.
- C. Shape and Texture: Provide units with machine-split textured.
  - 1. Face Dimensions: Mix of sizes providing appearance of random range ashlar stone masonry.
- D. Shape and Texture: Provide units of any basic shape and dimensions that produce segmental retaining walls of dimensions and profiles indicated without interfering with other elements of the Work.
- E. Batter: Provide units that offset from course below to provide batter.
- F. Cap Units: Provide cap units of same shape as other units with smooth, as-cast top surfaces without holes or lugs.
- G. Special Units: Provide corner units, end units, and other shapes as needed to produce segmental retaining walls of dimensions and to provide texture on exposed surfaces matching face.

## 2.3 INSTALLATION MATERIALS

- A. Cap Adhesive: Product supplied or recommended by segmental retaining wall unit manufacturer for adhering cap units to units below.
- B. Leveling Base: Comply with requirements as called out by design engineer.
- C. Drainage Fill: Comply with requirements as required by design engineer for drainage course.

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- D. Reinforced-Soil Fill: Comply with requirements in Section 312000 "Earth Moving" for satisfactory soils.
- E. Reinforced-Soil Fill: ASTM D2487; GW, GP, SW, SP, and SM soil classification groups or a combination of these groups; free of debris, waste, frozen materials, vegetation, and other deleterious matter; complying with the following gradation according to ASTM C136: 20 to 100 percent passing No. 4 sieve, zero to 60 percent passing No. 40 sieve, zero to 35 percent passing No. 200 sieve, and with fine fraction having a plasticity index of less than 20.
- F. Nonreinforced-Soil Fill: Comply with requirements in Section 312000 "Earth Moving" for satisfactory soils.
- G. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.
- H. Soil Reinforcement: Product specifically manufactured for use as soil reinforcement for the selected product and designed by engineer.

## 2.4 SOURCE QUALITY CONTROL

- A. Factory test and inspect each roll of soil reinforcement for minimum average roll values for geosynthetic index property tests, including the following:
  - 1. Weight.
  - 2. Grab or single-rib strength.
  - 3. Aperture opening.
  - 4. Rib or yarn size.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for excavation tolerances, condition of subgrades, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 RETAINING WALL INSTALLATION

- A. General: Place units according to NCMA's "Segmental Retaining Wall Installation Guide" and segmental retaining wall unit manufacturer's written instructions.
  - 1. Lay units in running bond.
  - 2. Form corners and ends by using special units.

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- B. Do not use units with chips, cracks, or other defects that are visible where such defects are exposed in the completed Work.
- C. Leveling Base: Place and compact base material to thickness indicated and with not less than 95 percent maximum dry unit weight according to ASTM D698.
  - 1. Leveling Course: At Contractor's option, unreinforced lean concrete may be substituted for upper 1 to 2 inches of base.
- D. First Course: Place first course of segmental retaining wall units for full length of wall. Place units in firm contact with each other, properly aligned and level.
  - 1. Tamp units into leveling base as necessary to bring tops of units into a level plane.
- E. Subsequent Courses: Remove excess fill and debris from tops of units in course below. Place units in firm contact, properly aligned, and directly on course below.
  - 1. For units with lugs designed to fit into holes in adjacent units, lay units so lugs are accurately aligned with holes, and bedding surfaces are firmly seated on beds of units below.
  - 2. For units with lips at front of units, slide units as far forward as possible for firm contact with lips of units below.
  - 3. For units with lips at bottom rear of units, slide units as far forward as possible for firm contact of lips with units below.
  - 4. For units with pins, install pins and align units.
  - 5. For units with clips, install clips and align units.
- F. Cap Units: Place cap units and secure with cap adhesive.

### 3.3 FILL PLACEMENT

- A. General: Comply with requirements in Section 312000 "Earth Moving," with NCMA's "Segmental Retaining Wall Installation Guide," and with segmental retaining wall unit manufacturer's written instructions.
- B. Fill voids between and within units with drainage fill. Place fill as each course of units is laid.
- C. Place, spread, and compact drainage fill and soil fill in uniform lifts for full width and length of embankment as wall is laid. Place and compact fills without disturbing alignment of units. Where both sides of wall are indicated to be filled, place fills on both sides at same time. Begin at wall, and place and spread fills toward embankment.
  - 1. Use only hand-operated compaction equipment within 48 inches of wall, or one-half of height above bottom of wall, whichever is greater.
  - 2. Compact reinforced-soil fill to not less than 95 percent maximum dry unit weight according to ASTM D698.
    - a. In areas where only hand-operated compaction equipment is allowed, compact fills to not less than 90 percent maximum dry unit weight according to ASTM D698.

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- D. Place drainage geotextile per manufacturers recommendation.
- E. Place a layer of drainage fill per manufacturers recommendation.
- F. Place impervious fill over top edge of drainage fill layer.
- G. Slope grade at top of wall away from wall unless otherwise indicated. Slope grade at wall base away from wall. Provide uniform slopes that prevent ponding.
- H. Place soil reinforcement in horizontal joints of retaining wall where indicated and according to soil-reinforcement manufacturer's written instructions..
  - 1. Place additional soil reinforcement at corners and curved walls to provide continuous reinforcement.
  - 2. Place geosynthetics with seams, if any, oriented perpendicular to segmental retaining walls.
  - 3. Do not dump fill material directly from trucks onto geosynthetics.

### 3.4 CONSTRUCTION TOLERANCES

- A. Variation from Level: For bed-joint lines along walls, do not exceed 1-1/4 inches in 10 feet, 3 inches maximum.
- B. Variation from Indicated Batter: For slope of wall face, do not vary from indicated slope by more than 1-1/4 inches in 10 feet
- C. Variation from Indicated Wall Line: For walls indicated as straight, do not vary from straight line by more than 1-1/4 inches in 10 feet
- D. Maximum Gap between Units: 1/8 inch

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Comply with requirements in Section 312000 "Earth Moving" for field quality control.
  - 1. In each compacted backfill layer, perform at least one field in-place compaction test for each 100 feet or less of segmental retaining wall length.
  - 2. In each compacted backfill layer, perform at least one field in-place compaction test for each 24 inches of fill depth and each 50 feet or less of segmental retaining wall length.

### 3.6 ADJUSTING

- A. Remove and replace segmental retaining wall construction of the following descriptions:

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1. Broken, chipped, stained, or otherwise damaged units. Units may be repaired if Architect approves methods and results.
  2. Segmental retaining walls that do not match approved Samples.
  3. Segmental retaining walls that do not comply with other requirements indicated.
- B. Replace units so segmental retaining wall matches approved Samples and mockups, complies with other requirements, and shows no evidence of replacement.

END OF SECTION 323223

## SECTION 329113

### SOIL PREPARATION

#### 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 planting soils and layered soil assemblies specified by composition of the mixes.
- B. Related Requirements:
  - 1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
  - 2. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.
  - 3. Section 329300 "Plants" for placing planting soil for plantings.

##### 1.3 DEFINITIONS

- A. AAPFCO: Association of American Plant Food Control Officials.
- B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.
- C. CEC: Cation exchange capacity.
- D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.
- E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.
- F. Imported Soil: Soil that is transported to Project site for use.
- G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.
- H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

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- I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.
- J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."
- K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.
- M. SSSA: Soil Science Society of America.
- N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- O. 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.
- P. 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.
- Q. USCC: U.S. Composting Council.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include recommendations for application and use.
  - 2. Include test data substantiating that products comply with requirements.
  - 3. Include sieve analyses for aggregate materials.
  - 4. Material Certificates: For each type of imported soil, soil amendment and fertilizer before delivery to the site, according to the following:
    - a. Manufacturer's qualified testing agency's certified analysis of standard products.
    - b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SU1P #25.
    - c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.



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## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For each testing agency.
- B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.
- C. Field quality-control reports.

## 1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

## 1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Contractor will engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil imported soil.
  - 1. Notify Engineer seven days in advance of the dates and times when laboratory samples will be taken.
- B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.
  - 1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

## 1.9 SOIL-SAMPLING REQUIREMENTS

- A. General: Extract soil samples according to requirements in this article.
- B. Sample Collection and Labeling: Have samples taken and labeled by Contractor in presence of Engineer under the direction of the testing agency.
  - 1. Number and Location of Samples: Minimum of three representative soil samples from each area where soil to be used or amended for landscaping purposes.
  - 2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."
  - 3. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

## 1.10 TESTING REQUIREMENTS

- A. General: Perform tests on soil samples according to requirements in this article.
- B. Physical Testing:
  - 1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":
    - a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
    - b. Hydrometer Method: Report percentages of sand, silt, and clay.
  - 2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
  - 3. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
  - 4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D698 (Standard Proctor).
- C. Chemical Testing:
  - 1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
  - 2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods."
  - 3. Metals Hazardous to Human Health: Test for presence and quantities of RCRA metals including aluminum, arsenic, barium, copper, cadmium, chromium, cobalt, lead, lithium, and vanadium. If RCRA metals are present, include recommendations for corrective action.
  - 4. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.
- D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of [SSSA NAPT NEC-67, including the following:
  - 1. Percentage of organic matter.
  - 2. CEC, calcium percent of CEC, and magnesium percent of CEC.
  - 3. Soil reaction (acidity/alkalinity pH value).
  - 4. Buffered acidity or alkalinity.
  - 5. Nitrogen ppm.
  - 6. Phosphorous ppm.
  - 7. Potassium ppm.
  - 8. Manganese ppm.

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9. Manganese-availability ppm.
  10. Zinc ppm.
  11. Zinc availability ppm.
  12. Copper ppm.
  13. Sodium ppm and sodium absorption ratio.
  14. Soluble-salts ppm.
  15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
  16. Other deleterious materials, including their characteristics and content of each.
- E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
- F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.
1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. for 6-inch depth of soil.
  2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inch depth of soil.

#### 1.11 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.
- B. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
  2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  3. Do not move or handle materials when they are wet or frozen.
  4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

## PART 2 - PRODUCTS

### 2.1 PLANTING SOILS SPECIFIED BY COMPOSITION

- A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.
- B. Definition: Topsoil shall be acceptable friable loam that is reasonably free of subsoils, clay lumps, litter, roots or other plant materials, stones larger than 1" in any direction, and other foreign materials. Topsoil shall have a minimum 60% passing through the No. 10 (2 mm) sieve as defined by AASHTO T88.
- C. EXISTING TOPSOIL: Existing, on-site surface soil, with the duff layer, if any, retained; and stockpiled on-site; modified to produce viable planting soil. Blend existing, on-site surface soil with soil amendments and fertilizers per written recommendations in the Soil Report to produce AMENDED TOPSOIL.
- D. IMPORTED TOPSOIL: Imported, naturally formed soil from off-site sources and consisting of sandy loam or loamy sand according to USDA textures; and modified soil amendments and fertilizers per written recommendations in the Soil Report to produce AMENDED TOPSOIL.
  - 1. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches deep, not from agricultural land, bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and brome grass.
  - 2. Additional Properties of Imported Soil before Amending: Soil reaction of pH 6 to 7 and minimum of 4percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
  - 3. Unacceptable Properties: Clean soil of the following:
    - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
    - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.
    - c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1 inch in any dimension.
- E. MANUFACTURED TOPSOIL: Manufactured soil consisting of manufacturer's basic topsoil or sandy loam according to USDA textures, blended in a manufacturing facility with sand, stabilized organic soil amendments, and other materials to produce AMENDED TOPSOIL.

1. Additional Properties of Manufacturer's Basic Soil before Amending: Soil reaction of pH 6 to 7 and minimum of 4 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
2. Unacceptable Properties: Manufactured soil shall not contain the following:
  - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
  - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 5 percent by dry weight of the manufactured soil.
  - c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1 inch in any dimension.

F. AMENDED TOPSOIL: Planting Soil Mix for turf and plants.

1. Before seeding, Amended Topsoil shall be amended to meet the following:
  - a. Texture of soil shall conform to the classification within the USDA triangle for Sandy Loam or Loamy Sand. Amended Topsoil shall have the following particle size distribution, as determined by pipette method in compliance with ASTM F-1632:

Sand:	40% to 60%	(0.05mm to 2 mm)
Silt:	15% to 45%	(0.002mm to 0.05mm)
Clay:	5% to 15%	(less than 0.002 mm)
  - b. Organic content of Planting Soil Mix shall have a range of 2% to 10% by weight as determined by the appropriate testing method listed herein. Adjust organic content of Amended Topsoil prior to placing the soil and finished grading.
  - c. The pH of the Amended Topsoil shall have a range of 6.0 to 7.0. Extremes shall be avoided.
  - d. The Amended Topsoil shall also be amended with fertilizer and lime as recommended by the Soil Test Report and to meet requirements.

2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
  1. Form: Provide lime in form of pelletized limestone.
  2. Apply at a rate as recommended in the Soil Test Reports. Apply mechanically at least two weeks prior to planting and fertilizer applications. Incorporate into full depth of planting soil prior to finished grading.

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- A. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.
- B. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- C. Perlite: Horticultural perlite, soil amendment grade.
- D. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M.

## 2.3 ORGANIC SOIL AMENDMENTS

- A. Compost: A commercially manufactured humus product that is dark, crumbly, fine textured, fully composted decayed organic matter specifically manufactured for use as a soil amendment to promote vegetative growth. Organic amendments shall be well-aged, and contain no visible admixture or refuse or other physical contaminants nor any material toxic to plant growth.
  - 1. Feedstock: Limited to leaves.
  - 2. Reaction: pH of the finished composted organic matter near 7.0, within the range of 6.0 to 8.0.
  - 3. Soluble-Salt Concentration: Less than 4 dS/m.
  - 4. Moisture Content: 35 to 55 percent by weight.
  - 5. Organic-Matter Content: 40% minimum on a dry weight basis as determined by loss on ignition.
  - 6. Particle Size: 100 percent passing through a ½"-inch screen.
  - 7. Carbon/Nitrogen Ratio: between 12:1 and 25:1.
  - 8. Degree of maturity: Composted organic matter shall be considered stable as determined by the Solvita compost maturity index. Compost must achieve a maturity index of 6 or better, indicating a curing active compost.
  - 9. Ammonium content: Ammonium shall be less than 400 ppm on a dry-weight basis.
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture with 100 percent passing through a 1/2-inch sieve, a pH of 3.4 to 4.8, and a soluble-salt content measured by electrical conductivity of maximum 5 dS/m.

## 2.4 FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
  - 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

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## 2.5 SAND

- A. Coarse Washed Sand with neutral pH.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.
- B. Proceed with placement only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

- A. Excavation: If on-site topsoil is to be stockpiled and reused, excavate soil from designated areas and stockpile until amended. Depth of topsoil may vary, generally between 4" and 6". Contractor shall make adjustments to excavation depths as necessary to avoid mixing subsoil with topsoil.
- B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
- C. Unsuitable Materials: Clean soil to contain a maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.

### 3.3 PLACING BLENDED AMENDED TOPSOIL OVER EXPOSED SUBGRADE

- A. General: Generally, Amended Topsoil is to be mixed before placement in its final location. For large lawn areas, Amended Topsoil may be mixed in place, with approval of the Engineer or Landscape Engineer. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Application:
  - 1. Preparation of areas to be topsoiled:
    - a. Verify that the subgrade is uniform and at the proper elevation to receive topsoil to the depth(s) required on the drawings. Correct discrepancies in the subgrade before proceeding. Loosen the subgrade surface to a depth of 2 inches and remove stones or other foreign material one inch or larger in dimension prior to placement of topsoil.
  - 2. Placing and spreading amended topsoil:

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- a. Till subgrade to a minimum depth of 8 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- b. Apply approximately two inches of the Amended Topsoil over prepared, loosened subgrade. Mix thoroughly into top 4 inches of subgrade.
- c. Spread remaining Amended Topsoil to meet depths as indicated on plan (4" minimum), and as required to meet finished grades after natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet. Compact each lift of to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698.
- d. Finish grade soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- e. Topsoiled areas to drain freely to drainage structures or dispersal points without ponding.
- f. Test for compaction before installing seed or sod.
- g. Install seed mix or sod in accordance with the applicable specification section.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor to engage a qualified testing agency to perform tests and inspections.
- B. Soil will be considered defective if it does not pass tests.
- C. Submit test reports.
- D. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

### 3.5 PROTECTION

- A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."
- B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
  1. Storage of construction materials, debris, or excavated material.
  2. Parking vehicles or equipment.
  3. Vehicle traffic.
  4. Foot traffic.
  5. Erection of sheds or structures.



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6. Impoundment of water.
  7. Excavation or other digging unless otherwise indicated.
- C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Engineer and replace contaminated planting soil with new planting soil.

### 3.6 CLEANING

- A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.
  1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION 329113

## SECTION 329300

### PLANTS

#### 1.1 SUMMARY

A. Section Includes:

1. Shrubs
2. Groundcover.
3. Mulches.
4. Related materials.

B. Related Requirements:

1. Division 32 Section "Finish Grading and Topsoil" for planting soil mixes.
2. Division 32 Section "Turf and Grasses" for turf (lawn) plantings.

#### 1.2 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.
- C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.
- D. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.
- E. Finish Grade: Elevation of finished surface of planting soil.
- F. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.
- G. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

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- H. Planting Area: Areas to be planted.
- I. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" for drawing designations for planting soils.
- J. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- K. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- L. Stem Girdling Roots: Roots that encircle the stems (trunks) of plants below the soil surface.
- M. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

### 1.3 COORDINATION

- A. Coordination with Turf Areas (Lawns): Plant shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
  - 1. When planting, protect turf areas, and promptly repair damage caused by planting operations.

### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Anti-desiccant spray
  - 2. Mycorrhizal inoculant.
  - 3. Pesticides and herbicides
- B. Samples for Verification: For each of the following:
  - 1. Organic Mulch: 1-quart volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
  - 2. Edging Materials and Accessories: 6" sample section.
- C. Plant Material:
  - 1. Location Data: Quantities and sizes of each plant material type, location of nursery, and location of growth (if different from nursery). Include address, phone number, and contact person for each nursery or other place of growth.

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2. Photographs: At least 14 days prior to submittal of Plant Material Location Data, submit three color photographs in digital format of each required species and size of plant material as it will be furnished to the Project.
  - a. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph.
  - b. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished.
  - c. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- B. For each type of manufactured product, from manufacturer, and complying with the following:
  1. Manufacturer's certified analysis of standard products.
  2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- C. Sample Warranty: For special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
  1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
- C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

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1. Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
  2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
- D. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Landscape Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
1. Notify Landscape Architect of sources of planting materials seven days in advance of delivery to site.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.
- B. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
  2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  3. Accompany each delivery of bulk materials with appropriate certificates.
- C. Do not prune shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie plants in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- D. Handle planting stock by root ball or the container. Do not lift or handle container plants by the tops, stems, or trunks. Do not bend or bind/tie shrubs in such a manner as to destroy their natural shape. Do not drop plants during delivery or handling.
- E. Apply antidesiccant to shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
1. If deciduous shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

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- F. Wrap shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation. Pad trunk and branches at all points of contact between plant material and equipment.
- G. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
  - 1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
  - 2. Do not remove container-grown stock from containers before time of planting.
  - 3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

#### 1.9 FIELD CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
  - 1. Spring Planting: March 15<sup>th</sup> through May 15<sup>th</sup>.
  - 2. Fall Planting: October 15<sup>th</sup> through November 30<sup>th</sup>.
- 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 according to manufacturer's written instructions and warranty requirements.

#### 1.10 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
    - b. Structural failures including plantings falling or blowing over.
    - c. Faulty performance of tree stabilization.
  - 2. Warranty Periods: From date of Substantial Completion.
    - a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
    - b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.

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- c. Delays in completion of planting operations which extend the planting into more than one planting season shall extend the Warranty Period accordingly.
3. Include the following remedial actions as a minimum:
  - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
  - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
  - c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
  - d. Provide extended warranty for period equal to original warranty period, for replaced plant material.
4. Incorrect Materials:
  - a. During Warranty Period, replace at no cost to the Owner, plants revealed as being untrue to name.
  - b. Provide replacements of a size and quality to match the planted materials at the time the mistake is discovered.

## PART 2 - PRODUCTS

### 2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning.
  1. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
  2. Provide plants with healthy, well developed root systems, free of kinked, circling, girdling and center roots, root-bound conditions, and cracked or broken root balls.
  3. Trunk and branches must be structurally strong and tree must be able to stand upright without stakes or guys on a windless day. Reject plants with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); with crossing trunks; or with cut-off limbs more than 3/4 inch in diameter.
  4. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

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5. Climatic Growing Conditions: Plant material shall be grown under climatic conditions similar to those of the project for at least two years unless otherwise accepted by the Landscape Architect.
  6. Container Growth Limitations: Container stock, excluding annuals, shall have been grown in the containers in which plant material is delivered for at least six months, but not more than two years.
  7. Do not prune, thin, or shape plants before delivery without approval of the Landscape Architect.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant. Plant nomenclature shall meet requirements of ICBN and ICNCP.
- E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

## 2.2 FERTILIZERS

- A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

## 2.3 MULCHES

- A. Organic Mulch: Free of soil, rocks, toxic material, weed seeds, and other deleterious materials, and suitable as a top dressing for plants. Mulch shall be of a uniform grade with no additives or any other treatment. The pH shall range from 5.8 to 6.2.
1. Shredded hardwood mulch.
    - a. Aged, double shredded.
    - b. Color: Natural.
  2. Composted Leaf Mulch



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## 2.4 PESTICIDES AND HERBICIDES

- A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

## PART 3 - EXECUTION

### 3.1 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 or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  - 2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
  - 3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  - 4. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Landscape Architect and replace with new planting soil.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf 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 shrub locations.
  - 1. Stake locations of plants where indicated on drawings.

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2. Lay out container grown shrubs and perennials as indicated on the drawings. Do not remove container grown shrubs from containers until time of planting.
3. Lay out a sample of ground cover spacing for review.
4. Contact the Landscape Architect to review locations prior to excavation of the plant pits. Adjust the locations in the field as directed by the Landscape Architect.
5. Do not excavate plant pits until the Landscape Architect has accepted the locations.

### 3.3 PLANTING AREA ESTABLISHMENT

- A. General: Prepare planting area for soil placement and mix planting soil according to division 32 Section "Finish Grade and Topsoil".
- B. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

### 3.4 EXCAVATION FOR SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits.
  1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
  2. Excavate plant pits to a diameter which is three times as wide as root ball diameter for shrubs.
  3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
  4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
  5. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
  6. Maintain supervision of excavations during working hours.
  7. Keep excavations covered or otherwise protected after working hours and when unattended by Installer's personnel.
- B. Backfill Soil: Topsoil as outlined in Division 32 Section "Topsoil and Finished Grading".
- C. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to shrubs are encountered in excavations.
  1. Hardpan Layer: Drill 6-inch-diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

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- D. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- E. Fill excavations with water and allow to percolate away before positioning shrubs.

### 3.5 SHRUB PLANTING

- A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.
  - 1. Backfill: Planting Soil mix as specified.
  - 2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
  - 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  - 4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
    - a. Quantity: Fertilization as recommended by soil testing reports.
  - 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. Balled and Potted and Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.
  - 1. Backfill: Planting Soil mix as specified.
  - 2. Carefully remove root ball from container without damaging root ball or plant.
  - 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  - 5. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.
    - a. Quantity: Fertilization as recommended by soil testing reports.
  - 6. Continue backfilling process. Water again after placing and tamping final layer of soil.

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- E. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

### 3.6 SHRUB PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Prune, thin, and shape plants as directed by Landscape Architect.
- C. Prune, thin, and shape plants according to standard professional horticultural and arboricultural practices, in accordance with the ANSI A300 Part I (Pruning) Standards from the Tree Care Industry Association. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured, dying, or dead branches from shrubs; and prune to retain natural character.
- D. Do not apply pruning paint to wounds.

### 3.7 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover as indicated on Drawings in even rows with triangular spacing.
- B. Backfill: Planting Soil mix as specified.
- C. Dig holes large enough to allow spreading of roots.
- D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.
- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

### 3.8 PLANTING AREA MULCHING

- A. Mulch backfilled surfaces of planting areas and other areas indicated.
  - 1. Organic Mulch in Planting Areas: Apply 3-inch average thickness of organic mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

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### 3.9 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.
- B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

### 3.10 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to planting areas according to manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

### 3.11 REPAIR AND REPLACEMENT

- A. General: Repair or replace existing or new plants that are damaged by construction operations at no cost to the Owner, in a manner approved by Landscape Architect.
  - 1. Submit details of proposed pruning and repairs.
  - 2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
  - 3. Replace plants that cannot be repaired and restored to full-growth status, as determined by Landscape Architect.
- B. Remove and replace plants 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 Landscape Architect determines are incapable of restoring to normal growth pattern, at no cost to the Owner.
  - 1. Provide new plants of same size as those being replaced.
  - 2. Species of replacement plants: Same species being replaced.
- C. Plant Warranty will apply to replaced plant materials.

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3.12 CLEANING AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.
- C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

END OF SECTION 329300

SECTION 330500

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. Grout.
  - 4. Piped utility demolition.
  - 5. Piping system common requirements.
  - 6. Equipment installation common requirements.

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. ABS: Acrylonitrile-butadiene-styrene plastic.
- D. CPVC: Chlorinated polyvinyl chloride plastic.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.

1.4 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.

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- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

## 1.5 COORDINATION

- A. Coordinate size and location of concrete bases. Formwork, reinforcement, and concrete requirements are specified in Division 03.

## PART 2 - PRODUCTS

### 2.1 PIPING 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. Solvent Cements for Joining Plastic Piping:
  - 1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

### 2.2 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, 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.
- 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.



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### 3.2 PIPING INSTALLATION

- A. Install piping according to the following requirements and Division 33 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.

### 3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 33 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### 3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

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3.5 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.

3.6 GROUTING

- A. Clean surfaces that will come into contact with grout.
- B. Provide forms as required for placement of grout.
- C. Avoid air entrapment during placement of grout.
- D. Cure placed grout.

END OF SECTION 330500

SECTION 334100

STORM UTILITY 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 gravity-flow, non-pressure storm drainage with the following components:
  - 1. Special fittings for expansion and deflection.
  - 2. Cleanouts.
  - 3. Drains.
  - 4. Precast concrete manholes.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene-monomer rubber.
- C. LLDPE: Linear low-density, polyethylene plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. DIP: Ductile Iron Pipe
- H. HDPE: High Density Polyethylene

1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Pipes and associated joints
  - 2. Inlets
  - 3. Manholes
  - 4. Underground Basin
- B. Shop Drawings: For the following:
  - 1. Manholes: Include plans, elevations, sections, details, and frames and covers.

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2. Stormwater Inlets. Include plans, elevations, sections, details, and frames, covers, and grates.
  3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames and covers
- C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- D. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.
- E. Field quality-control test reports.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.
- D. Handle stormwater inlets according to manufacturer's written rigging instructions.

#### 1.6 PROJECT CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  1. Notify Architect no fewer than two days in advance of proposed interruption of service.
  2. Do not proceed with interruption of service without Owner's written permission.

### PART 2 - PRODUCTS

#### 2.1 DUCTILE-IRON

- A. Push-on-Joint Piping:
  1. Pipe: AWWA C151, for push-on joints.
  2. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.
  3. Gaskets: AWWA C111, rubber, of shape matching pipe and fittings.

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## 2.2 NONPRESSURE-TYPE PIPE COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
  - 1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
  - 2. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- C. Shielded Flexible 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. Available Manufacturers:
    - a. Cascade Waterworks Mfg.
    - b. Dallas Specialty & Mfg. Co.
    - c. Mission Rubber Company; a division of MCP Industries, Inc.
  - 2. .

## 2.3 STORMWATER INLETS

- A. Curb Inlets: Made with vertical curb opening, of materials and dimensions according to PADOT publication 408.
- B. Frames and Grates: Heavy-duty frames and grates according to PADOT publication 408.

## 2.4 PIPE OUTLETS

- A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.
- B. Energy Dissipaters: According to NSSGA's "Quarried Stone for Erosion and Sediment Control," No. A-1, 3-ton (2721-kg) average weight armor stone, unless otherwise indicated.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

### 3.2 PIPING APPLICATIONS

- A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
  - 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.
    - a. Shielded flexible or rigid couplings for same or minor difference OD pipes.
    - b. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
- B. Gravity-Flow, Non-pressure Sewer Piping: Use any of the following pipe materials for each size range:
  - 1. NPS 15: Ductile Iron sewer pipe and fittings, gaskets, and gasketed joints.
  - 2. HDPE: High Density Poly Ethelene

### 3.3 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated 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 use of lubricants, cements, and other installation requirements.
- C. No utility piping shall be installed without permits from the respected jurisdiction.
- D. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- E. 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.
- F. Install gravity-flow, non-pressure drainage piping according to the following:
  - 1. Install piping pitched down in direction of flow, at minimum slope, unless otherwise indicated.

### 3.4 PIPE JOINT CONSTRUCTION

- A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. Join gravity-flow, non-pressure drainage piping according to PADOT Publication 408

### 3.5 STORMWATER INLET INSTALLATION

- A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

### 3.6 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318/318R

### 3.7 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
  - 1. Submit separate reports 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. 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. Reinspect and repeat procedure until results are satisfactory.
- B. 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 by owners representative..
  - 2. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
  - 3. Gravity-Flow Storm Drainage Piping: Test according to requirements of the plans..
- C. Leaks constitute defects that must be repaired.

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- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

### 3.8 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION 334100



SECTION 334600

SUBDRAINAGE

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. Perforated pipe and fittings.
  - 2. Drainage conduits.
  - 3. Geotextile filter fabrics.

1.3 ACTION SUBMITTALS

- A. Product Data:
  - 1. Drainage conduits, including rated capacities.
  - 2. Geotextile filter fabrics.

PART 2 - PRODUCTS

2.1 PERFORATED-WALL PIPES AND FITTINGS

- A. Perforated PE Pipe and Fittings:
  - 1. NPS 6 and Smaller: ASTM F 405 or AASHTO M 252, Type CP; corrugated, for coupled joints.
  - 2. Couplings: Manufacturer's standard, band type.
- B. Perforated HDPE Sewer Pipe and Fittings: ASTM D 2729, bell-and-spigot ends, for loose joints.

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## 2.2 DRAINAGE CONDUITS

- A. Single-Pipe Drainage Conduits: Prefabricated geocomposite with perforated corrugated core molded from HDPE complying with ASTM D 3350 and wrapped in geotextile filter fabric.
  - 1. Nominal Size: 6 inches high by approximately 0.5 inch thick.
    - a. Minimum In-Plane Flow: 30 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.
  - 2. Filter Fabric: PP geotextile.
  - 3. Fittings: HDPE with combination NPS 4 and NPS 6 outlet connection.
  - 4. Couplings: Corrugated HDPE band.

## 2.3 SOIL MATERIALS

- A. Soil materials are specified in Section 31 2000 "Earth Moving."

## 2.4 WATERPROOFING FELTS

- A. Material: Comply with ASTM D 226, Type I, asphalt or ASTM D 227, coal-tar-saturated organic felt.

## 2.5 GEOTEXTILE FILTER FABRICS

- A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. when tested according to ASTM D 4491.
- B. Structure Type: Nonwoven, needle-punched continuous filament.
  - 1. Survivability: AASHTO M 288 Class 2.
  - 2. Styles: Flat and sock.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.
- B. If subdrainage is required for landscaping, locate and mark existing utilities, underground structures, and aboveground obstructions before beginning installation and avoid disruption and damage of services.

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- C. Verify that drainage panels installed as part of foundation wall waterproofing is properly positioned to drain into subdrainage system.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 31 2000 "Earth Moving."

### 3.3 LANDSCAPING DRAINAGE INSTALLATION

- A. Provide trench width to allow installation of drainage conduit. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.
- B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.
- C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.
- D. Install drainage conduits as indicated in Part 3 "Piping Installation" Article for landscaping subdrainage with horizontal distance of at least 6 inches between conduit and trench walls. Wrap drainage conduits without integral geotextile filter fabric with flat-style geotextile filter fabric before installation. Connect fabric sections with adhesive or tape.
- E. Add drainage course to top of drainage conduits.
- F. After satisfactory testing, cover drainage conduit to within 12 inches of finish grade.
- G. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.
- H. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.
- I. Fill to Grade: Place satisfactory soil fill material over drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Fill to finish grade.

### 3.4 PIPING INSTALLATION

- A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.
  - 1. Foundation Subdrainage: Install piping level and with a minimum cover of 36 inches unless otherwise indicated.

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2. Underslab Subdrainage: Install piping level.
  3. Plaza Deck Subdrainage: Install piping level.
  4. Retaining-Wall Subdrainage: When water discharges at end of wall into stormwater piping system, install piping level and with a minimum cover of 36 inches unless otherwise indicated.
  5. Landscaping Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 36 inches unless otherwise indicated.
  6. Lay perforated pipe with perforations down.
  7. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.
- B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.
- C. Install thermoplastic piping according to ASTM D 2321.

### 3.5 PIPE JOINT CONSTRUCTION

- A. Join perforated PE pipe and fittings with couplings according to ASTM D 3212 with loose banded, coupled, or push-on joints.
- B. Join perforated PVC sewer pipe and fittings according to ASTM D 3212 with loose bell-and-spigot, push-on joints.
- C. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

### 3.6 BACKWATER VALVE INSTALLATION

- A. Comply with requirements for backwater valves specified in Section 33 4100 "Storm Utility Drainage Piping."
- B. Install horizontal backwater valves in header piping downstream from perforated subdrainage piping.
- C. Install horizontal backwater valves in piping in manholes or pits where indicated.

### 3.7 CLEANOUT INSTALLATION

- A. Comply with requirements for cleanouts specified in Section 334100 "Storm Utility Drainage Piping."
- B. Cleanouts for Foundation Retaining-Wall and Landscaping Subdrainage:

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1. Install cleanouts from piping to grade. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.
2. In vehicular-traffic areas, use NPS 4 cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 18 by 18 by 12 inches deep. Set top of cleanout flush with grade.
3. In nonvehicular-traffic areas, use NPS 4 PVC pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 12 by 12 by 4 inches deep. Set top of cleanout 1 inch above grade.
4. Comply with requirements for concrete specified in Section 03 3000 "Cast-in-Place Concrete."

C. Cleanouts for Underslab Subdrainage:

1. Install cleanouts and riser extensions from piping to top of slab. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.
2. Use NPS 4 cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout flush with top of slab.

### 3.8 CONNECTIONS

- A. Comply with requirements for piping specified in Section 334100 "Storm Utility Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect low elevations of subdrainage system to solid-wall-piping storm drainage system.
- C. Where required, connect low elevations of foundation subdrainage to stormwater sump pumps. Comply with requirements for sump pumps specified in Section 22 1429 "Sump Pumps."

### 3.9 IDENTIFICATION

- A. Arrange for installation of green warning tapes directly over piping. Comply with requirements for underground warning tapes specified in specified in Section 31 2000 "Earth Moving."
1. Install PE warning tape or detectable warning tape over ferrous piping.
2. Install detectable warning tape over nonferrous piping and over edges of underground structures.

### 3.10 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling.

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2. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

B. Drain piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

### 3.11 CLEANING

- A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION 334600