

September 23, 2026 – BID ISSUE

Bid Package 1 - HVAC Renovations and Upgrades at BES, DES, NEES, VFMS, CHS & WVAB

Beaumont Elementary School

*575 Beaumont Road
Devon, PA 19333*

Devon Elementary School

*400 S. Fairfield Road
Devon, PA 19333*

New Eagle Elementary School

*507 Pugh Road
Wayne, PA 19087*

Valley Forge Middle School

*105 W. Walker Road
Wayne, PA 19087*

Conestoga High School

*200 Irish Road
Berwyn, PA 19312*

West Valley Administration Building

*940 West Valley Road, Suite 1700
Wayne, PA 19087*

For the

Tredyffrin / Easttown School District

940 West Valley Road, Suite 1700, Wayne, Pennsylvania, 19087 t 620 240 1900

SPECIFICATIONS

HSA Project No. 26-016.01

Schiller & Hersh Associates, Inc.

Consulting M/E/P Engineers

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

t 215 886 8947 f 215 886 8956

A.W. Lookup Corporation

Structural Engineers

500 Fayette Street, Suite 100, Conshohocken, Pennsylvania 19428

t 610 825 2600 f 610 825 2781



Heckendorn Shiles Architects

347 E Conestoga Rd, Wayne, Pennsylvania 19087 t 610 994 3500

#26-016.01

TOC - 1

Division 0/1 ITEM

NOTICE TO BIDDERS
INSTRUCTIONS TO BIDDERS

PENNSYLVANIA EXEMPTION CERTIFICATE
BID BOND
NON-COLLUSION AFFIDAVIT
CONTRACTORS QUALIFICATION STATEMENT

PERFORMANCE (and Maintenance) BOND
LABOR AND MATERIAL PAYMENT BOND
PREVAILING MINIMUM WAGE DETERMINATIONS – BES
PREVAILING MINIMUM WAGE DETERMINATIONS – DES
PREVAILING MINIMUM WAGE DETERMINATIONS – NEES
PREVAILING MINIMUM WAGE DETERMINATIONS – VFMS
PREVAILING MINIMUM WAGE DETERMINATIONS – CHS
PREVAILING MINIMUM WAGE DETERMINATIONS – WVAB

GENERAL CONDITIONS OF THE CONTRACT FOR CONTRACTOR – AIA A201
SUPPLEMENTARY GENERAL CONDITIONS
GENERAL REQUIREMENTS
FORM OF AGREEMENT
BIDDER’S CHECKLIST

010410 PROJECT COORDINATION – MULTIPLE PRIME CONTRACTS
013000 SUBMITTAL PROCEDURES
014000 QUALITY REQUIREMENTS
017700 CLOSEOUT PROCEDURES

ARCHITECTURAL

024119 SELECTIVE DEMOLITION
042000 UNIT MASONRY
061053 MISCELLANEOUS ROUGH CARPENTRY
070151 ROOFING REPAIRING
072100 THERMAL INSULATION
076200 SHEET METAL FLASHING AND TRIM
078413 PENETRATION FIRESTOPPING
079200 JOINT SEALANTS
089000 LOUVERS AND VENTS
095113 ACOUSTICAL PANEL CEILINGS
099000 PAINTING AND COATING
323113 CHAINLINK FENCING AND GATES

PLUMBING

220000 PLUMBING SUMMARY OF WORK
220500 COMMON WORK RESULTS FOR PLUMBING
220523 GENERAL-DUTY VALVES FOR PLUMBING PIPING
220529 HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
220553 IDENTIFICATIONS FOR PLUMBING PIPING AND EQUIPMENT
220700 PLUMBING INSULATION
221116 DOMESTIC WATER PIPING

#26-016.01

TOC - 2

221119 DOMESTIC WATER PIPING SPECIALTIES

MECHANICAL

230000	SUMMARY OF WORK
230130	HVAC AIR-DISTRIBUTION SYSTEM CLEANING
230500	COMMON WORK RESULTS FOR HVAC
230513	COMMON MOTOR REQUIREMENTS
230519	METERS AND GAGES FOR HVAC PIPING.
230523	GENERAL-DUTY VALVES FOR PIPING
230529	HANGERS & SUPPORTS FOR HVAC PIPING & EQUIPMENT
230553	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
230593	TESTING, ADJUSTING, AND BALANCING FOR HVAC
230700	HVAC INSULATION
230900	INSTRUMENTATION AND CONTROL FOR HVAC
230993	SEQUENCE OF OPERATIONS FOR HVAC CONTROLS
231433	FACILITY NATURAL GAS PIPING
232113	HYDRONIC PIPING
232300	REFRIGERANT PIPING
233113	METAL DUCTS
233300	AIR DUCT ACCESSORIES
233423	HVAC POWER VENTILATORS
233713	DIFFUSERS, REGISTERS AND GRILLES
237313	INDOOR AIR HANDLING UNITS
237433	ROOF TOP UNITS
238126	SPLIT-SYSTEM AIR-CONDITIONERS
238216	AIR COILS

ELECTRICAL

260000	SUMMARY OF WORK
260400	BASIC ELECTRICAL REQUIREMENTS
260500	COMMON WORK RESULTS FOR ELECTRICAL
260519	LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
260526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
260529	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
260533	RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
260553	IDENTIFICATION FOR ELECTRICAL SYSTEMS
260923	LIGHTING CONTROL DEVICES
262416	PANELBOARDS
262726	WIRING DEVICES

END OF TABLE OF CONTENTS

NOTICE TO BIDDERS

Bid Package 1 - HVAC Renovations and Upgrades at Beaumont Elementary School (BES), Devon Elementary School (DES), New Eagle Elementary School (NEES), Valley Forge Middle School (VFMS), Conestoga High School (CHS), and the West Valley Administration Building (WVAB) for **the Tredyffrin/Easttown School District**

Bids will be received electronically before **2:00 P.M., Tuesday, October 27, 2026, 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.

Contract	Proposal Guaranty
General Construction	10%
Mechanical Construction	10%
Electrical Construction	10%
Plumbing 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. Plans and specifications will be available **September 23, 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 Wednesday, September 30, 2026, at 8:30 A.M. at Conestoga High School, large group room 142, 200 Irish 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

INSTRUCTIONS TO BIDDERS

BID PACKAGE 1 - HVAC RENOVATIONS AND UPGRADES AT BEAUMONT ELEMENTARY SCHOOL (BES), DEVON ELEMENTARY SCHOOL (DES), NEW EAGLE ELEMENTARY SCHOOL (NEES), VALLEY FORGE MIDDLE SCHOOL (VFMS), CONESTOGA HIGH SCHOOL (CHS), AND THE WEST VALLEY ADMINISTRATION BUILDING (WVAB)

INDEX

SECTION 1	- RECEIVING, OPENING, AND READING OF PROPOSALS
SECTION 2	- PREPARATION OF PROPOSALS & CONTRACTOR QUALIFICATIONS
SECTION 3	- IDENTIFICATION AND SUBMISSIONS OF PROPOSALS
SECTION 4	- PROPOSAL GUARANTY
SECTION 5	- WITHDRAWAL OF BIDS
SECTION 6	- AWARD OF CONTRACT OR REJECTION OF PROPOSALS
SECTION 7	- CONTRACT BONDS & OTHER PRE-CONTRACT REQUIREMENTS
SECTION 8	- EXECUTION OF CONTRACT & COMMENCEMENT OF WORK
SECTION 9	- NOT USED
SECTION 10	- RESPONSIBILITY OF BIDDER
SECTION 11	- CHANGE PRIOR TO OPENING OF PROPOSALS
SECTION 12	- TIME OF COMPLETION: EXTENSIONS OF TIME
SECTION 13	- DOCUMENTS
SECTION 14	- INSPECTIONS & TESTING
SECTION 15	- INSURANCE
SECTION 16	- SUBSTITUTIONS
SECTION 17	- DETAILED COST BREAKDOWN
SECTION 18	- COMPETENT WORKMEN
SECTION 19	- PAYMENTS
SECTION 20	- OCCUPATIONAL SAFETY AND HEALTH ACT REQUIREMENTS
SECTION 21	- PROVISIONS FOR THE USE OF STEEL AND STEEL PRODUCTS MADE IN THE U.S.A.
SECTION 22	- HUMAN RELATIONS ACT
SECTION 23	- STANDARD OF QUALITY
SECTION 24	- REQUIREMENTS OF ANTI-POLLUTION LEGISLATION
SECTION 25	- PENNSYLVANIA PREVAILING WAGE RATES
SECTION 26	- ASBESTOS & LEAD
SECTION 27	- APPLICATION BACKGROUND CHECKS REQUIRED
SECTION 28	- LIQUIDATED DAMAGES
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:

Bid Package 1 - HVAC Renovations and Upgrades at BES, DES, NEES, VFMS, CHS & WVAB

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 **2:00 pm, October 27, 2026.**

The bids will be unsealed electronically via the PennBid website, and also will be read aloud at **2:00 pm, October 27, 2026.**

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.

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

C. A **mandatory Pre-Bid Meeting** (project walk-through) will be held on **Wednesday, September 30, 2026 at 8:30 A.M.** at Conestoga High School, large group room 142, 200 Irish 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 **3:30pm, Thursday, October 8, 2026.**

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.

#26-016.01

IB - 3

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, 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 or 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.

#26-016.01

IB - 4

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 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.

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.

- 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.dgs.pa.gov/Businesses/Materials%20and%20Services%20Procurement/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 late November 2026 with an anticipated site mobilization of June 21, 2027. This long lag-time is designed to provide adequate opportunity for the Contractor to process, order and receive all materials for the work in advance of the mobilization date.

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.

- 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 August 18, 2027.

#26-016.01

IB - 8

1. **NOTE:** Contractors are notified that any work that occurs on or after August 18, 2027, including scheduled work and regardless of the reason, shall be performed on **Second Shift**, and between the hours of 3:30 pm and 11:00 pm, or third shift at no additional cost to the Owner.

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: Bid Package 1 - HVAC Renovations and Upgrades at BES, DES, NEES, VFMS, CHS & WVAB - Specifications
 2. Drawings are as follows:
 - See Sheet A001 on Bid Package 1 - HVAC Renovations and Upgrades at BES
 - See Sheet A001 on Bid Package 1 - HVAC Renovations and Upgrades at DES
 - See Sheet A001 on Bid Package 1 - HVAC Renovations and Upgrades at NEES
 - See Sheet A001 on Bid Package 1 - HVAC Renovations and Upgrades at VFMS
 - See Sheet A001 on Bid Package 1 - HVAC Renovations and Upgrades at CHS
 - See Sheet A001 on Bid Package 1 - HVAC Renovations and Upgrades at WVAB

SECTION 14 -INSPECTIONS & TESTING

- A. The Owner will engage testing agencies. Each Prime Contractor 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.

#26-016.01

IB - 9

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.
- 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 25th 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.
- 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.

#26-016.01

IB - 11

- 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 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>
- 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 Final completion shall be delayed beyond the time for Final completion set forth in Section 12 of these Instructions to Bidders.

Contract	Damages/Day
General Construction	\$ 1,000.00
Mechanical Construction	\$ 1,000.00
Plumbing Construction	\$ 1,000.00
Electrical Construction	\$ 1,000.00

Site Mobilization: **June 21, 2027**
Project Final Completion: **August 18, 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

#26-016.01

IB - 13

- 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.
- 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;

#26-016.01

IB - 14

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;
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

#26-016.01

IB - 15

- Government Grants, Contracts and Cooperative Agreements,” and any implementing regulations issued by the awarding agency.
- 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 in advance of site mobilization. As noted elsewhere,

#26-016.01

IB - 16

the Mechanical Controls Subcontractor is to be Tri-M Group, LLC, Kennett Square, PA (610-444-1000)
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.

THE AMERICAN INSTITUTE OF ARCHITECTS



AIA Document A310

Bid Bond

KNOW ALL MEN BY THESE PRESENTS, that we

(Here insert full name and address or legal title of Contractor)

as Principal, hereinafter called the Principal, and

(Here insert full name and address or legal title of Surety)

a corporation duly organized under the laws of the State of
as Surety, hereinafter called the Surety, are held and firmly bound unto

(Here insert full name and address or legal title of Owner)

as Obligee, hereinafter called the Obligee, in the sum of

Dollars (\$),

for the payment of which sum well and truly to be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid for

(Here insert full name, address and description of project)

NOW, THEREFORE, if the Obligee shall accept the bid of the Principal and the Principal shall enter into a Contract with the Obligee in accordance with the terms of such bid, and give such bond or bonds as may be specified in the bidding or Contract Documents with good and sufficient surety for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof, or in the event of the failure of the Principal to enter such Contract and give such bond or bonds, if the Principal shall pay to the Obligee the difference not to exceed the penalty hereof between the amount specified in said bid and such larger amount for which the Obligee may in good faith contract with another party to perform the Work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect.

Signed and sealed this

day of

20

(Witness) { _____
(Principal) (Seal)

(Title)

(Witness) { _____
(Surety) (Seal)

(Title)

#26-016.01

NCA - 1

NON-COLLUSION AFFIDAVIT

**Bid Package 1 - HVAC Renovations and Upgrades at BES, DES, NEES, VFMS, CHS & WVAB
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)

#26-016.01

NCA - 2

Authorized Signature

Printed Name

Company Position

SWORN TO AND SUBSCRIBED

BEFORE ME THIS _____ DAY OF _____, 20__

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)

Copyright 1964, 1969, 1979, ©1986 by The American Institute of Architects, 1735 New York Avenue, N.W., Washington, D.C. 20006. Reproduction of the material herein or substantial quotation of its provisions without written permission of the AIA violates the copyright laws of the United States and will be subject to legal prosecution.

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-subsidary).

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:

#26-016.01

PB - 1

PERFORMANCE BOND

Bid Package 1 - HVAC Renovations and Upgrades at BES, DES, NEES, VFMS, CHS & WVAB 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");

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

#26-016.01

PB - 2

Bond to become binding upon the award of a contract to the Principal by the Oblige 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 Oblige and

WHEREAS, under the Contract Documents, it is provided, inter alia, that if the Principal shall furnish this Bond to the Oblige, and if the Oblige shall make an award to the Principal in accordance with the Proposal, then the Principal and the Oblige 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 Oblige and all of its officers, directors, agents or employees from any and all costs and damages which the Oblige 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 Oblige any and all costs, damages and expenses, including interest and attorney's fees) which the Oblige 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 Oblige, 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 Oblige of the work to be performed under the Agreement in accordance with the Contract Documents, which defects, in the sole judgment of the Oblige 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 Oblige toward the other with respect to the Contract Documents and the Agreement, or the reduction of any percentage to be retained by 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

#26-016.01

PB - 3

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.

#26-016.01

PB - 4

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

#26-016.01

PLMB - 1

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.

#26-016.01

PLMB - 2

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.

#26-016.01

PLMB - 3

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

BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project Name:	HVAC Renovations and Upgrades at Beaumont Elementary School
General Description:	Replacement of RTU's with associated electrical and general trades work.
Project Locality	575 Beaumont Road, Devon, PA 1
Awarding Agency:	Tredyffrin Easttown School District
Contract Award Date:	11/23/2026
Serial Number:	26-08381
Project Classification:	Building
Determination Date:	9/17/2026
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: 26-08381 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Asbestos & Insulation Workers	5/1/2025		\$60.84	\$48.71	\$109.55
Asbestos & Insulation Workers	5/1/2026		\$64.51	\$50.26	\$114.77
Boilermakers	3/1/2018		\$45.89	\$33.73	\$79.62
Bricklayer	5/1/2025		\$50.00	\$32.57	\$82.57
Bricklayer	5/1/2026		\$51.15	\$34.92	\$86.07
Carpenter - Chief of Party (Surveying & Layout)	5/1/2025		\$54.59	\$29.02	\$83.61
Carpenter - Instrument Person (Surveying & Layout)	5/1/2025		\$47.47	\$29.02	\$76.49
Carpenter - Rodman (Surveying & Layout)	5/1/2025		\$23.74	\$20.62	\$44.36
Carpenters	5/1/2026		\$48.55	\$30.39	\$78.94
Carpenters	5/1/2027		\$50.46	\$30.74	\$81.20
Carpenters	5/1/2028		\$52.43	\$31.09	\$83.52
Carpenters	5/1/2029		\$54.46	\$31.44	\$85.90
Carpenters	5/1/2030		\$56.55	\$31.79	\$88.34
Cement Finishers & Plasterers	5/1/2022		\$38.57	\$32.39	\$70.96
Cement Masons	5/1/2024		\$46.70	\$32.46	\$79.16
Cement Masons	5/1/2025		\$48.70	\$32.46	\$81.16
Dockbuilder, Pile Drivers	5/1/2026		\$56.98	\$37.99	\$94.97
Dockbuilder/Pile Driver Diver	5/1/2026		\$66.54	\$41.74	\$108.28
Dockbuilder/pile driver tender	5/1/2026		\$56.98	\$37.99	\$94.97
Drywall Finisher	5/1/2025		\$40.14	\$32.35	\$72.49
Drywall Finisher	5/1/2026		\$41.10	\$32.99	\$74.09
Electricians	6/1/2026		\$55.25	\$41.28	\$96.53
Electricians	5/31/2027		\$57.33	\$42.80	\$100.13
Electricians	5/29/2028		\$59.49	\$44.14	\$103.63
Electricians	5/28/2029		\$61.64	\$45.49	\$107.13
Elevator Constructor	1/1/2025		\$71.85	\$45.77	\$117.62
Elevator Constructor	1/1/2026		\$74.86	\$46.86	\$121.72
Floor Coverer	5/1/2025		\$51.67	\$31.69	\$83.36
Floor Coverer	5/1/2026		\$52.84	\$32.86	\$85.70
Glazier	5/1/2025		\$49.96	\$38.34	\$88.30
Glazier	5/1/2026		\$51.30	\$39.37	\$90.67
Interior Finish	5/1/2023		\$34.60	\$25.80	\$60.40
Iron Workers (Bridge, Structural, Ornamental, Precast)	7/1/2024		\$53.20	\$45.01	\$98.21
Iron Workers (Riggers)	7/1/2025		\$44.77	\$36.27	\$81.04
Iron Workers (Riggers)	7/1/2026		\$48.84	\$36.52	\$85.36
Iron Workers (Rodman/Reinforcing)	7/1/2024		\$47.70	\$34.77	\$82.47
Iron Workers (Rodman/Reinforcing)	7/1/2025		\$47.80	\$36.65	\$84.45
Iron Workers (Rodman/Reinforcing)	7/1/2026		\$52.39	\$36.90	\$89.29
Laborers (Class 01 - See notes)	5/1/2025		\$37.25	\$26.10	\$63.35
Laborers (Class 02 - See notes)	5/1/2025		\$41.00	\$27.70	\$68.70
Laborers (Class 03 - See notes)	5/1/2025		\$37.67	\$26.28	\$63.95
Laborers (Class 04 - See notes)	5/1/2025		\$37.67	\$26.28	\$63.95
Laborers (Class 05 - See notes)	5/1/2025		\$37.25	\$26.10	\$63.35
Landscape Laborer	5/1/2025		\$32.15	\$24.30	\$56.45

BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project: 26-08381 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Marble Finisher	5/1/2025		\$41.17	\$30.75	\$71.92
Marble Finisher	5/1/2026		\$42.07	\$31.85	\$73.92
Marble Mason	5/1/2023		\$47.20	\$31.95	\$79.15
Marble Setter	5/1/2026		\$51.50	\$33.80	\$85.30
Mason Tender, Cement	5/1/2023		\$35.02	\$25.98	\$61.00
Millwright	5/1/2025		\$57.39	\$35.81	\$93.20
Millwright	5/1/2026		\$60.20	\$35.81	\$96.01
Operators (Building, Class 01 - See Notes)	5/1/2025		\$54.52	\$34.49	\$89.01
Operators (Building, Class 01 - See Notes)	5/1/2026		\$55.67	\$35.34	\$91.01
Operators (Building, Class 01A - See Notes)	5/1/2025		\$57.52	\$35.38	\$92.90
Operators (Building, Class 01A - See Notes)	5/1/2026		\$58.68	\$36.22	\$94.90
Operators (Building, Class 02 - See Notes)	5/1/2025		\$54.27	\$34.42	\$88.69
Operators (Building, Class 02 - See Notes)	5/1/2026		\$55.43	\$35.26	\$90.69
Operators (Building, Class 02A - See Notes)	5/1/2025		\$57.29	\$35.29	\$92.58
Operators (Building, Class 02A - See Notes)	5/1/2026		\$58.44	\$36.14	\$94.58
Operators (Building, Class 03 - See Notes)	5/1/2025		\$50.18	\$33.22	\$83.40
Operators (Building, Class 03 - See Notes)	5/1/2026		\$51.34	\$34.06	\$85.40
Operators (Building, Class 04 - See Notes)	5/1/2025		\$49.88	\$33.13	\$83.01
Operators (Building, Class 04 - See Notes)	5/1/2026		\$51.04	\$33.97	\$85.01
Operators (Building, Class 05 - See Notes)	5/1/2025		\$48.16	\$32.62	\$80.78
Operators (Building, Class 05 - See Notes)	5/1/2026		\$49.32	\$33.46	\$82.78
Operators (Building, Class 06 - See Notes)	5/1/2025		\$47.17	\$32.33	\$79.50
Operators (Building, Class 06 - See Notes)	5/1/2026		\$48.34	\$33.16	\$81.50
Operators (Building, Class 07A- See Notes)	5/1/2025		\$66.26	\$39.55	\$105.81
Operators (Building, Class 07A- See Notes)	5/1/2026		\$67.73	\$40.48	\$108.21
Operators (Building, Class 07B- See Notes)	5/1/2025		\$65.97	\$39.46	\$105.43
Operators (Building, Class 07B- See Notes)	5/1/2026		\$67.44	\$40.39	\$107.83
Painters Class 1 (see notes)	5/1/2025		\$44.38	\$34.55	\$78.93
Painters Class 1 (see notes)	5/1/2026		\$45.71	\$35.22	\$80.93
Painters - Line Stripping	12/1/2024		\$44.12	\$27.91	\$72.03
Painters - Line Stripping	12/1/2025		\$45.12	\$29.41	\$74.53
Painters Class 4 (see notes)	5/1/2025		\$46.47	\$34.55	\$81.02
Painters Class 4 (see notes)	5/1/2026		\$48.45	\$35.22	\$83.67
Plasterers	5/1/2024		\$39.88	\$33.08	\$72.96
plumber	5/1/2025		\$70.53	\$39.46	\$109.99
plumber	5/1/2026		\$73.73	\$40.36	\$114.09
Pointers, Caulkers, Cleaners	5/1/2025		\$51.35	\$31.80	\$83.15
Pointers, Caulkers, Cleaners	5/1/2026		\$53.35	\$32.30	\$85.65
Roofers (Composition)	5/1/2025		\$46.03	\$34.77	\$80.80
Roofers (Composition)	5/1/2026		\$47.53	\$35.22	\$82.75
Roofers (Shingle)	5/1/2024		\$34.35	\$22.20	\$56.55
Roofers (Slate & Tile)	5/1/2024		\$37.35	\$22.20	\$59.55
Sheet Metal Workers	5/1/2025		\$62.62	\$52.17	\$114.79
Sheet Metal Workers	5/1/2026		\$65.06	\$54.48	\$119.54

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08381 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Sign Makers and Hangars	7/15/2025		\$33.48	\$26.41	\$59.89
Sign Makers and Hangars	7/15/2026		\$36.38	\$25.01	\$61.39
Sprinklerfitters	1/1/2023		\$62.23	\$31.99	\$94.22
Sprinklerfitters	5/1/2025		\$70.37	\$34.85	\$105.22
Steamfitters	5/1/2024		\$70.32	\$43.09	\$113.41
Steamfitters	5/1/2025		\$72.52	\$44.89	\$117.41
Stone Masons	5/1/2025		\$50.00	\$32.80	\$82.80
Stone Masons	5/1/2026		\$51.50	\$33.80	\$85.30
Terrazzo Finisher	5/1/2025		\$45.61	\$29.41	\$75.02
Terrazzo Finisher	5/1/2026		\$47.78	\$29.61	\$77.39
Terrazzo Grinder	5/1/2025		\$45.88	\$29.41	\$75.29
Terrazzo Grinder	5/1/2026		\$47.78	\$29.61	\$77.39
Terrazzo Mechanics	5/1/2025		\$52.21	\$31.26	\$83.47
Terrazzo Mechanics	5/1/2026		\$53.36	\$32.61	\$85.97
Tile Finisher	5/1/2025		\$41.17	\$30.75	\$71.92
Tile Finisher	5/1/2026		\$42.07	\$31.85	\$73.92
Tile Setter	5/1/2025		\$52.21	\$31.26	\$83.47
Tile Setter	5/1/2026		\$53.36	\$32.61	\$85.97
Truckdriver class 1(see notes)	5/1/2024		\$36.79	\$22.54	\$59.33
Truckdriver class 1(see notes)	5/1/2026		\$38.57	\$23.87	\$62.44
Truckdriver class 2 (see notes)	5/1/2024		\$36.89	\$22.54	\$59.43
Truckdriver class 2 (see notes)	5/1/2026		\$38.67	\$23.87	\$62.54
Truckdriver class 3 (see notes)	5/1/2026		\$38.92	\$23.87	\$62.79
Window Film / Tint Installer	6/1/2025		\$27.42	\$15.13	\$42.55

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08381 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Bricklayer	5/1/2025		\$50.00	\$32.57	\$82.57
Bricklayer	5/1/2026		\$51.15	\$34.92	\$86.07
Carpenter - Chief of Party (Surveying & Layout)	5/1/2025		\$65.96	\$30.09	\$96.05
Carpenter - Chief of Party (Surveying & Layout)	5/1/2026		\$67.52	\$30.44	\$97.96
Carpenter - Instrument Person (Surveying & Layout)	5/1/2025		\$58.39	\$29.06	\$87.45
Carpenter - Instrument Person (Surveying & Layout)	5/1/2026		\$60.09	\$29.06	\$89.15
Carpenter - Rodman (Surveying & Layout)	5/1/2025		\$45.88	\$23.19	\$69.07
Carpenter - Rodman (Surveying & Layout)	5/1/2026		\$46.97	\$23.54	\$70.51
Carpenter	5/1/2025		\$57.36	\$30.09	\$87.45
Carpenter	5/1/2026		\$58.71	\$30.44	\$89.15
Cement Masons	5/1/2023		\$43.20	\$32.91	\$76.11
Cement Masons	5/1/2025		\$46.55	\$32.66	\$79.21
Dockbuilder, Pile Drivers	5/1/2026		\$56.98	\$37.99	\$94.97
Dockbuilder/Pile Driver Diver	5/1/2026		\$61.88	\$45.47	\$107.35
Dockbuilder/pile driver tender	5/1/2026		\$56.98	\$37.99	\$94.97
Electric Lineman	6/3/2024		\$62.07	\$33.96	\$96.03
Electric Lineman	6/2/2025		\$65.10	\$34.45	\$99.55
Iron Workers (Bridge, Structural, Ornamental, Precast)	7/1/2024		\$53.20	\$45.01	\$98.21
Iron Workers (Riggers)	7/1/2023		\$42.53	\$34.14	\$76.67
Iron Workers (Rodman/Reinforcing)	7/1/2023		\$45.70	\$34.77	\$80.47
Laborers (Class 01 - See notes)	5/1/2025		\$40.20	\$27.80	\$68.00
Laborers (Class 01 - See notes)	5/1/2026		\$41.65	\$27.90	\$69.55
Laborers (Class 02 - See notes)	5/1/2025		\$40.40	\$27.80	\$68.20
Laborers (Class 02 - See notes)	5/1/2026		\$41.85	\$27.90	\$69.75
Laborers (Class 03 - See notes)	5/1/2025		\$40.40	\$27.80	\$68.20
Laborers (Class 03 - See notes)	5/1/2026		\$41.85	\$27.90	\$69.75
Laborers (Class 04 - See notes)	5/1/2025		\$35.00	\$27.80	\$62.80
Laborers (Class 04 - See notes)	5/1/2026		\$36.45	\$27.90	\$64.35
Laborers (Class 05 - See notes)	5/1/2025		\$41.05	\$27.80	\$68.85
Laborers (Class 05 - See notes)	5/1/2026		\$42.50	\$27.90	\$70.40
Laborers (Class 06 - See notes)	5/1/2025		\$41.10	\$27.80	\$68.90
Laborers (Class 06 - See notes)	5/1/2026		\$42.55	\$27.90	\$70.45
Laborers (Class 07 - See notes)	5/1/2025		\$40.95	\$27.80	\$68.75
Laborers (Class 07 - See notes)	5/1/2026		\$42.40	\$27.90	\$70.30
Laborers (Class 08 - See notes)	5/1/2025		\$40.70	\$27.80	\$68.50
Laborers (Class 08 - See notes)	5/1/2026		\$42.15	\$27.90	\$70.05
Laborers (Class 09 - See notes)	5/1/2025		\$40.55	\$27.80	\$68.35
Laborers (Class 09 - See notes)	5/1/2026		\$42.00	\$27.90	\$69.90
Laborers (Class 10- See notes)	5/1/2025		\$40.70	\$27.80	\$68.50
Laborers (Class 10- See notes)	5/1/2026		\$42.15	\$27.90	\$70.05
Laborers (Class 11 -See Notes)	5/1/2025		\$40.60	\$27.80	\$68.40
Laborers (Class 11 -See Notes)	5/1/2026		\$42.05	\$27.90	\$69.95
Laborers (Class 12 -See Notes)	5/1/2025		\$42.30	\$27.80	\$70.10
Laborers (Class 12 -See Notes)	5/1/2026		\$42.85	\$27.90	\$70.75

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08381 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Laborers (Class 13 -See Notes)	5/1/2025		\$44.33	\$27.80	\$72.13
Laborers (Class 13 -See Notes)	5/1/2026		\$45.78	\$27.90	\$73.68
Laborers (Class 14 -See Notes)	5/1/2025		\$40.90	\$27.80	\$68.70
Laborers (Class 14 -See Notes)	5/1/2026		\$41.90	\$27.90	\$69.80
Laborers Utility (PGW ONLY) (Flagperson)	5/1/2025		\$34.07	\$19.73	\$53.80
Laborers Utility (PGW ONLY) (Flagperson)	5/1/2026		\$35.52	\$19.83	\$55.35
Laborers Utility (PGW ONLY)	5/1/2024		\$39.70	\$19.63	\$59.33
Laborers Utility (PGW ONLY)	5/1/2025		\$41.10	\$19.73	\$60.83
Laborers Utility (PGW ONLY)	5/1/2026		\$42.55	\$19.83	\$62.38
Landscape Laborer	5/1/2024		\$30.28	\$24.05	\$54.33
Landscape Laborer	5/1/2025		\$31.73	\$24.15	\$55.88
Millwright	5/1/2025		\$57.39	\$35.81	\$93.20
Millwright	5/1/2026		\$60.20	\$35.81	\$96.01
Operators Class 01 - See Notes (Building, Heavy, Highway)	5/1/2025		\$54.52	\$34.49	\$89.01
Operators Class 01 - See Notes (Building, Heavy, Highway)	5/1/2026		\$55.67	\$35.34	\$91.01
Operators Class 01a - See Notes (Building, Heavy, Highway)	5/1/2025		\$57.52	\$35.38	\$92.90
Operators Class 01a - See Notes (Building, Heavy, Highway)	5/1/2026		\$58.68	\$36.22	\$94.90
Operators Class 02 - See Notes (Building, Heavy, Highway)	5/1/2025		\$54.27	\$34.42	\$88.69
Operators Class 02 - See Notes (Building, Heavy, Highway)	5/1/2026		\$55.43	\$35.26	\$90.69
Operators Class 02a - See Notes (Building, Heavy, Highway)	5/1/2025		\$57.29	\$35.29	\$92.58
Operators Class 02a - See Notes (Building, Heavy, Highway)	5/1/2026		\$58.44	\$36.14	\$94.58
Operators Class 03 - See Notes (Building, Heavy, Highway)	5/1/2025		\$50.18	\$33.22	\$83.40
Operators Class 03 - See Notes (Building, Heavy, Highway)	5/1/2026		\$51.34	\$34.06	\$85.40
Operators Class 04 - See Notes (Building, Heavy, Highway)	5/1/2025		\$49.88	\$33.13	\$83.01
Operators Class 04 - See Notes (Building, Heavy, Highway)	5/1/2026		\$51.04	\$33.97	\$85.01
Operators Class 05 - See Notes (Building, Heavy, Highway)	5/1/2025		\$48.16	\$32.62	\$80.78
Operators Class 05 - See Notes (Building, Heavy, Highway)	5/1/2026		\$49.32	\$33.46	\$82.78
Operators Class 06 - See Notes (Building, Heavy, Highway)	5/1/2025		\$47.17	\$32.33	\$79.50
Operators Class 06 - See Notes (Building, Heavy, Highway)	5/1/2026		\$48.34	\$33.16	\$81.50
Operators Class 07 (A) - See Notes (Building, Heavy, Highway)	5/1/2025		\$66.26	\$39.55	\$105.81
Operators Class 07 (A) - See Notes (Building, Heavy, Highway)	5/1/2026		\$67.73	\$40.48	\$108.21
Operators Class 07 (B) - See Notes (Building, Heavy, Highway)	5/1/2025		\$65.97	\$39.46	\$105.43

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08381 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Operators Class 07 (B) - See Notes (Building, Heavy, Highway)	5/1/2026		\$67.44	\$40.39	\$107.83
Painters - Line Stripping	12/1/2024		\$44.12	\$27.91	\$72.03
Painters - Line Stripping	12/1/2025		\$45.12	\$29.41	\$74.53
Painters Class 2 (see notes)	2/1/2025		\$50.85	\$33.91	\$84.76
Painters Class 2 (see notes)	2/1/2026		\$51.61	\$35.00	\$86.61
Painters Class 3 (see notes)	2/1/2025		\$61.81	\$33.95	\$95.76
Painters Class 3 (see notes)	2/1/2026		\$62.57	\$35.04	\$97.61
Pointers, Caulkers, Cleaners	5/1/2025		\$51.35	\$31.80	\$83.15
Steamfitters (Heavy and Highway - Gas Distribution)	5/1/2025		\$68.89	\$44.73	\$113.62
Steamfitters	5/1/2018		\$56.37	\$34.39	\$90.76
Truckdriver class 1(see notes)	5/1/2024		\$36.64	\$22.54	\$59.18
Truckdriver class 1(see notes)	5/1/2026		\$38.42	\$23.87	\$62.29
Truckdriver class 2 (see notes)	5/1/2024		\$36.74	\$22.54	\$59.28
Truckdriver class 2 (see notes)	5/1/2026		\$38.52	\$23.87	\$62.39
Truckdriver class 3 (see notes)	5/1/2026		\$38.77	\$23.87	\$62.64

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project Name:	HVAC Renovations and Upgrades at Devon Elementary School
General Description:	Replacement of heat pumps with associated electrical and general trades work. Update of building mechanical controllers.
Project Locality	400 S Fairfield Road, Devon, P
Awarding Agency:	Tredyffrin Easttown School District
Contract Award Date:	11/23/2026
Serial Number:	26-08382
Project Classification:	Building
Determination Date:	9/17/2026
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: 26-08382 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Asbestos & Insulation Workers	5/1/2025		\$60.84	\$48.71	\$109.55
Asbestos & Insulation Workers	5/1/2026		\$64.51	\$50.26	\$114.77
Boilermakers	3/1/2018		\$45.89	\$33.73	\$79.62
Bricklayer	5/1/2025		\$50.00	\$32.57	\$82.57
Bricklayer	5/1/2026		\$51.15	\$34.92	\$86.07
Carpenter - Chief of Party (Surveying & Layout)	5/1/2025		\$54.59	\$29.02	\$83.61
Carpenter - Instrument Person (Surveying & Layout)	5/1/2025		\$47.47	\$29.02	\$76.49
Carpenter - Rodman (Surveying & Layout)	5/1/2025		\$23.74	\$20.62	\$44.36
Carpenters	5/1/2026		\$48.55	\$30.39	\$78.94
Carpenters	5/1/2027		\$50.46	\$30.74	\$81.20
Carpenters	5/1/2028		\$52.43	\$31.09	\$83.52
Carpenters	5/1/2029		\$54.46	\$31.44	\$85.90
Carpenters	5/1/2030		\$56.55	\$31.79	\$88.34
Cement Finishers & Plasterers	5/1/2022		\$38.57	\$32.39	\$70.96
Cement Masons	5/1/2024		\$46.70	\$32.46	\$79.16
Cement Masons	5/1/2025		\$48.70	\$32.46	\$81.16
Dockbuilder, Pile Drivers	5/1/2026		\$56.98	\$37.99	\$94.97
Dockbuilder/Pile Driver Diver	5/1/2026		\$66.54	\$41.74	\$108.28
Dockbuilder/pile driver tender	5/1/2026		\$56.98	\$37.99	\$94.97
Drywall Finisher	5/1/2025		\$40.14	\$32.35	\$72.49
Drywall Finisher	5/1/2026		\$41.10	\$32.99	\$74.09
Electricians	6/1/2026		\$55.25	\$41.28	\$96.53
Electricians	5/31/2027		\$57.33	\$42.80	\$100.13
Electricians	5/29/2028		\$59.49	\$44.14	\$103.63
Electricians	5/28/2029		\$61.64	\$45.49	\$107.13
Elevator Constructor	1/1/2025		\$71.85	\$45.77	\$117.62
Elevator Constructor	1/1/2026		\$74.86	\$46.86	\$121.72
Floor Coverer	5/1/2025		\$51.67	\$31.69	\$83.36
Floor Coverer	5/1/2026		\$52.84	\$32.86	\$85.70
Glazier	5/1/2025		\$49.96	\$38.34	\$88.30
Glazier	5/1/2026		\$51.30	\$39.37	\$90.67
Interior Finish	5/1/2023		\$34.60	\$25.80	\$60.40
Iron Workers (Bridge, Structural, Ornamental, Precast)	7/1/2024		\$53.20	\$45.01	\$98.21
Iron Workers (Riggers)	7/1/2025		\$44.77	\$36.27	\$81.04
Iron Workers (Riggers)	7/1/2026		\$48.84	\$36.52	\$85.36
Iron Workers (Rodman/Reinforcing)	7/1/2024		\$47.70	\$34.77	\$82.47
Iron Workers (Rodman/Reinforcing)	7/1/2025		\$47.80	\$36.65	\$84.45
Iron Workers (Rodman/Reinforcing)	7/1/2026		\$52.39	\$36.90	\$89.29
Laborers (Class 01 - See notes)	5/1/2025		\$37.25	\$26.10	\$63.35
Laborers (Class 02 - See notes)	5/1/2025		\$41.00	\$27.70	\$68.70
Laborers (Class 03 - See notes)	5/1/2025		\$37.67	\$26.28	\$63.95
Laborers (Class 04 - See notes)	5/1/2025		\$37.67	\$26.28	\$63.95
Laborers (Class 05 - See notes)	5/1/2025		\$37.25	\$26.10	\$63.35
Landscape Laborer	5/1/2025		\$32.15	\$24.30	\$56.45

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08382 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Marble Finisher	5/1/2025		\$41.17	\$30.75	\$71.92
Marble Finisher	5/1/2026		\$42.07	\$31.85	\$73.92
Marble Mason	5/1/2023		\$47.20	\$31.95	\$79.15
Marble Setter	5/1/2026		\$51.50	\$33.80	\$85.30
Mason Tender, Cement	5/1/2023		\$35.02	\$25.98	\$61.00
Millwright	5/1/2025		\$57.39	\$35.81	\$93.20
Millwright	5/1/2026		\$60.20	\$35.81	\$96.01
Operators (Building, Class 01 - See Notes)	5/1/2025		\$54.52	\$34.49	\$89.01
Operators (Building, Class 01 - See Notes)	5/1/2026		\$55.67	\$35.34	\$91.01
Operators (Building, Class 01A - See Notes)	5/1/2025		\$57.52	\$35.38	\$92.90
Operators (Building, Class 01A - See Notes)	5/1/2026		\$58.68	\$36.22	\$94.90
Operators (Building, Class 02 - See Notes)	5/1/2025		\$54.27	\$34.42	\$88.69
Operators (Building, Class 02 - See Notes)	5/1/2026		\$55.43	\$35.26	\$90.69
Operators (Building, Class 02A - See Notes)	5/1/2025		\$57.29	\$35.29	\$92.58
Operators (Building, Class 02A - See Notes)	5/1/2026		\$58.44	\$36.14	\$94.58
Operators (Building, Class 03 - See Notes)	5/1/2025		\$50.18	\$33.22	\$83.40
Operators (Building, Class 03 - See Notes)	5/1/2026		\$51.34	\$34.06	\$85.40
Operators (Building, Class 04 - See Notes)	5/1/2025		\$49.88	\$33.13	\$83.01
Operators (Building, Class 04 - See Notes)	5/1/2026		\$51.04	\$33.97	\$85.01
Operators (Building, Class 05 - See Notes)	5/1/2025		\$48.16	\$32.62	\$80.78
Operators (Building, Class 05 - See Notes)	5/1/2026		\$49.32	\$33.46	\$82.78
Operators (Building, Class 06 - See Notes)	5/1/2025		\$47.17	\$32.33	\$79.50
Operators (Building, Class 06 - See Notes)	5/1/2026		\$48.34	\$33.16	\$81.50
Operators (Building, Class 07A- See Notes)	5/1/2025		\$66.26	\$39.55	\$105.81
Operators (Building, Class 07A- See Notes)	5/1/2026		\$67.73	\$40.48	\$108.21
Operators (Building, Class 07B- See Notes)	5/1/2025		\$65.97	\$39.46	\$105.43
Operators (Building, Class 07B- See Notes)	5/1/2026		\$67.44	\$40.39	\$107.83
Painters Class 1 (see notes)	5/1/2025		\$44.38	\$34.55	\$78.93
Painters Class 1 (see notes)	5/1/2026		\$45.71	\$35.22	\$80.93
Painters - Line Stripping	12/1/2024		\$44.12	\$27.91	\$72.03
Painters - Line Stripping	12/1/2025		\$45.12	\$29.41	\$74.53
Painters Class 4 (see notes)	5/1/2025		\$46.47	\$34.55	\$81.02
Painters Class 4 (see notes)	5/1/2026		\$48.45	\$35.22	\$83.67
Plasterers	5/1/2024		\$39.88	\$33.08	\$72.96
plumber	5/1/2025		\$70.53	\$39.46	\$109.99
plumber	5/1/2026		\$73.73	\$40.36	\$114.09
Pointers, Caulkers, Cleaners	5/1/2025		\$51.35	\$31.80	\$83.15
Pointers, Caulkers, Cleaners	5/1/2026		\$53.35	\$32.30	\$85.65
Roofers (Composition)	5/1/2025		\$46.03	\$34.77	\$80.80
Roofers (Composition)	5/1/2026		\$47.53	\$35.22	\$82.75
Roofers (Shingle)	5/1/2024		\$34.35	\$22.20	\$56.55
Roofers (Slate & Tile)	5/1/2024		\$37.35	\$22.20	\$59.55
Sheet Metal Workers	5/1/2025		\$62.62	\$52.17	\$114.79
Sheet Metal Workers	5/1/2026		\$65.06	\$54.48	\$119.54

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08382 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Sign Makers and Hangars	7/15/2025		\$33.48	\$26.41	\$59.89
Sign Makers and Hangars	7/15/2026		\$36.38	\$25.01	\$61.39
Sprinklerfitters	1/1/2023		\$62.23	\$31.99	\$94.22
Sprinklerfitters	5/1/2025		\$70.37	\$34.85	\$105.22
Steamfitters	5/1/2024		\$70.32	\$43.09	\$113.41
Steamfitters	5/1/2025		\$72.52	\$44.89	\$117.41
Stone Masons	5/1/2025		\$50.00	\$32.80	\$82.80
Stone Masons	5/1/2026		\$51.50	\$33.80	\$85.30
Terrazzo Finisher	5/1/2025		\$45.61	\$29.41	\$75.02
Terrazzo Finisher	5/1/2026		\$47.78	\$29.61	\$77.39
Terrazzo Grinder	5/1/2025		\$45.88	\$29.41	\$75.29
Terrazzo Grinder	5/1/2026		\$47.78	\$29.61	\$77.39
Terrazzo Mechanics	5/1/2025		\$52.21	\$31.26	\$83.47
Terrazzo Mechanics	5/1/2026		\$53.36	\$32.61	\$85.97
Tile Finisher	5/1/2025		\$41.17	\$30.75	\$71.92
Tile Finisher	5/1/2026		\$42.07	\$31.85	\$73.92
Tile Setter	5/1/2025		\$52.21	\$31.26	\$83.47
Tile Setter	5/1/2026		\$53.36	\$32.61	\$85.97
Truckdriver class 1(see notes)	5/1/2024		\$36.79	\$22.54	\$59.33
Truckdriver class 1(see notes)	5/1/2026		\$38.57	\$23.87	\$62.44
Truckdriver class 2 (see notes)	5/1/2024		\$36.89	\$22.54	\$59.43
Truckdriver class 2 (see notes)	5/1/2026		\$38.67	\$23.87	\$62.54
Truckdriver class 3 (see notes)	5/1/2026		\$38.92	\$23.87	\$62.79
Window Film / Tint Installer	6/1/2025		\$27.42	\$15.13	\$42.55

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08382 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Bricklayer	5/1/2025		\$50.00	\$32.57	\$82.57
Bricklayer	5/1/2026		\$51.15	\$34.92	\$86.07
Carpenter - Chief of Party (Surveying & Layout)	5/1/2025		\$65.96	\$30.09	\$96.05
Carpenter - Chief of Party (Surveying & Layout)	5/1/2026		\$67.52	\$30.44	\$97.96
Carpenter - Instrument Person (Surveying & Layout)	5/1/2025		\$58.39	\$29.06	\$87.45
Carpenter - Instrument Person (Surveying & Layout)	5/1/2026		\$60.09	\$29.06	\$89.15
Carpenter - Rodman (Surveying & Layout)	5/1/2025		\$45.88	\$23.19	\$69.07
Carpenter - Rodman (Surveying & Layout)	5/1/2026		\$46.97	\$23.54	\$70.51
Carpenter	5/1/2025		\$57.36	\$30.09	\$87.45
Carpenter	5/1/2026		\$58.71	\$30.44	\$89.15
Cement Masons	5/1/2023		\$43.20	\$32.91	\$76.11
Cement Masons	5/1/2025		\$46.55	\$32.66	\$79.21
Dockbuilder, Pile Drivers	5/1/2026		\$56.98	\$37.99	\$94.97
Dockbuilder/Pile Driver Diver	5/1/2026		\$61.88	\$45.47	\$107.35
Dockbuilder/pile driver tender	5/1/2026		\$56.98	\$37.99	\$94.97
Electric Lineman	6/3/2024		\$62.07	\$33.96	\$96.03
Electric Lineman	6/2/2025		\$65.10	\$34.45	\$99.55
Iron Workers (Bridge, Structural, Ornamental, Precast)	7/1/2024		\$53.20	\$45.01	\$98.21
Iron Workers (Riggers)	7/1/2023		\$42.53	\$34.14	\$76.67
Iron Workers (Rodman/Reinforcing)	7/1/2023		\$45.70	\$34.77	\$80.47
Laborers (Class 01 - See notes)	5/1/2025		\$40.20	\$27.80	\$68.00
Laborers (Class 01 - See notes)	5/1/2026		\$41.65	\$27.90	\$69.55
Laborers (Class 02 - See notes)	5/1/2025		\$40.40	\$27.80	\$68.20
Laborers (Class 02 - See notes)	5/1/2026		\$41.85	\$27.90	\$69.75
Laborers (Class 03 - See notes)	5/1/2025		\$40.40	\$27.80	\$68.20
Laborers (Class 03 - See notes)	5/1/2026		\$41.85	\$27.90	\$69.75
Laborers (Class 04 - See notes)	5/1/2025		\$35.00	\$27.80	\$62.80
Laborers (Class 04 - See notes)	5/1/2026		\$36.45	\$27.90	\$64.35
Laborers (Class 05 - See notes)	5/1/2025		\$41.05	\$27.80	\$68.85
Laborers (Class 05 - See notes)	5/1/2026		\$42.50	\$27.90	\$70.40
Laborers (Class 06 - See notes)	5/1/2025		\$41.10	\$27.80	\$68.90
Laborers (Class 06 - See notes)	5/1/2026		\$42.55	\$27.90	\$70.45
Laborers (Class 07 - See notes)	5/1/2025		\$40.95	\$27.80	\$68.75
Laborers (Class 07 - See notes)	5/1/2026		\$42.40	\$27.90	\$70.30
Laborers (Class 08 - See notes)	5/1/2025		\$40.70	\$27.80	\$68.50
Laborers (Class 08 - See notes)	5/1/2026		\$42.15	\$27.90	\$70.05
Laborers (Class 09 - See notes)	5/1/2025		\$40.55	\$27.80	\$68.35
Laborers (Class 09 - See notes)	5/1/2026		\$42.00	\$27.90	\$69.90
Laborers (Class 10- See notes)	5/1/2025		\$40.70	\$27.80	\$68.50
Laborers (Class 10- See notes)	5/1/2026		\$42.15	\$27.90	\$70.05
Laborers (Class 11 -See Notes)	5/1/2025		\$40.60	\$27.80	\$68.40
Laborers (Class 11 -See Notes)	5/1/2026		\$42.05	\$27.90	\$69.95
Laborers (Class 12 -See Notes)	5/1/2025		\$42.30	\$27.80	\$70.10
Laborers (Class 12 -See Notes)	5/1/2026		\$42.85	\$27.90	\$70.75

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08382 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Laborers (Class 13 -See Notes)	5/1/2025		\$44.33	\$27.80	\$72.13
Laborers (Class 13 -See Notes)	5/1/2026		\$45.78	\$27.90	\$73.68
Laborers (Class 14 -See Notes)	5/1/2025		\$40.90	\$27.80	\$68.70
Laborers (Class 14 -See Notes)	5/1/2026		\$41.90	\$27.90	\$69.80
Laborers Utility (PGW ONLY) (Flagperson)	5/1/2025		\$34.07	\$19.73	\$53.80
Laborers Utility (PGW ONLY) (Flagperson)	5/1/2026		\$35.52	\$19.83	\$55.35
Laborers Utility (PGW ONLY)	5/1/2024		\$39.70	\$19.63	\$59.33
Laborers Utility (PGW ONLY)	5/1/2025		\$41.10	\$19.73	\$60.83
Laborers Utility (PGW ONLY)	5/1/2026		\$42.55	\$19.83	\$62.38
Landscape Laborer	5/1/2024		\$30.28	\$24.05	\$54.33
Landscape Laborer	5/1/2025		\$31.73	\$24.15	\$55.88
Millwright	5/1/2025		\$57.39	\$35.81	\$93.20
Millwright	5/1/2026		\$60.20	\$35.81	\$96.01
Operators Class 01 - See Notes (Building, Heavy, Highway)	5/1/2025		\$54.52	\$34.49	\$89.01
Operators Class 01 - See Notes (Building, Heavy, Highway)	5/1/2026		\$55.67	\$35.34	\$91.01
Operators Class 01a - See Notes (Building, Heavy, Highway)	5/1/2025		\$57.52	\$35.38	\$92.90
Operators Class 01a - See Notes (Building, Heavy, Highway)	5/1/2026		\$58.68	\$36.22	\$94.90
Operators Class 02 - See Notes (Building, Heavy, Highway)	5/1/2025		\$54.27	\$34.42	\$88.69
Operators Class 02 - See Notes (Building, Heavy, Highway)	5/1/2026		\$55.43	\$35.26	\$90.69
Operators Class 02a - See Notes (Building, Heavy, Highway)	5/1/2025		\$57.29	\$35.29	\$92.58
Operators Class 02a - See Notes (Building, Heavy, Highway)	5/1/2026		\$58.44	\$36.14	\$94.58
Operators Class 03 - See Notes (Building, Heavy, Highway)	5/1/2025		\$50.18	\$33.22	\$83.40
Operators Class 03 - See Notes (Building, Heavy, Highway)	5/1/2026		\$51.34	\$34.06	\$85.40
Operators Class 04 - See Notes (Building, Heavy, Highway)	5/1/2025		\$49.88	\$33.13	\$83.01
Operators Class 04 - See Notes (Building, Heavy, Highway)	5/1/2026		\$51.04	\$33.97	\$85.01
Operators Class 05 - See Notes (Building, Heavy, Highway)	5/1/2025		\$48.16	\$32.62	\$80.78
Operators Class 05 - See Notes (Building, Heavy, Highway)	5/1/2026		\$49.32	\$33.46	\$82.78
Operators Class 06 - See Notes (Building, Heavy, Highway)	5/1/2025		\$47.17	\$32.33	\$79.50
Operators Class 06 - See Notes (Building, Heavy, Highway)	5/1/2026		\$48.34	\$33.16	\$81.50
Operators Class 07 (A) - See Notes (Building, Heavy, Highway)	5/1/2025		\$66.26	\$39.55	\$105.81
Operators Class 07 (A) - See Notes (Building, Heavy, Highway)	5/1/2026		\$67.73	\$40.48	\$108.21
Operators Class 07 (B) - See Notes (Building, Heavy, Highway)	5/1/2025		\$65.97	\$39.46	\$105.43

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08382 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Operators Class 07 (B) - See Notes (Building, Heavy, Highway)	5/1/2026		\$67.44	\$40.39	\$107.83
Painters - Line Stripping	12/1/2024		\$44.12	\$27.91	\$72.03
Painters - Line Stripping	12/1/2025		\$45.12	\$29.41	\$74.53
Painters Class 2 (see notes)	2/1/2025		\$50.85	\$33.91	\$84.76
Painters Class 2 (see notes)	2/1/2026		\$51.61	\$35.00	\$86.61
Painters Class 3 (see notes)	2/1/2025		\$61.81	\$33.95	\$95.76
Painters Class 3 (see notes)	2/1/2026		\$62.57	\$35.04	\$97.61
Pointers, Caulkers, Cleaners	5/1/2025		\$51.35	\$31.80	\$83.15
Steamfitters (Heavy and Highway - Gas Distribution)	5/1/2025		\$68.89	\$44.73	\$113.62
Steamfitters	5/1/2018		\$56.37	\$34.39	\$90.76
Truckdriver class 1(see notes)	5/1/2024		\$36.64	\$22.54	\$59.18
Truckdriver class 1(see notes)	5/1/2026		\$38.42	\$23.87	\$62.29
Truckdriver class 2 (see notes)	5/1/2024		\$36.74	\$22.54	\$59.28
Truckdriver class 2 (see notes)	5/1/2026		\$38.52	\$23.87	\$62.39
Truckdriver class 3 (see notes)	5/1/2026		\$38.77	\$23.87	\$62.64

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project Name:	HVAC Renovations and Upgrades at New Eagle Elementary School
General Description:	Replacement of large split AC unit with associated electrical and general trades work.
Project Locality	507 Pugh Road, Wayne, PA 19087
Awarding Agency:	Tredyffrin Easttown School District
Contract Award Date:	11/23/2026
Serial Number:	26-08383
Project Classification:	Building
Determination Date:	9/17/2026
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: 26-08383 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Asbestos & Insulation Workers	5/1/2025		\$60.84	\$48.71	\$109.55
Asbestos & Insulation Workers	5/1/2026		\$64.51	\$50.26	\$114.77
Boilermakers	3/1/2018		\$45.89	\$33.73	\$79.62
Bricklayer	5/1/2025		\$50.00	\$32.57	\$82.57
Bricklayer	5/1/2026		\$51.15	\$34.92	\$86.07
Carpenter - Chief of Party (Surveying & Layout)	5/1/2025		\$54.59	\$29.02	\$83.61
Carpenter - Instrument Person (Surveying & Layout)	5/1/2025		\$47.47	\$29.02	\$76.49
Carpenter - Rodman (Surveying & Layout)	5/1/2025		\$23.74	\$20.62	\$44.36
Carpenters	5/1/2026		\$48.55	\$30.39	\$78.94
Carpenters	5/1/2027		\$50.46	\$30.74	\$81.20
Carpenters	5/1/2028		\$52.43	\$31.09	\$83.52
Carpenters	5/1/2029		\$54.46	\$31.44	\$85.90
Carpenters	5/1/2030		\$56.55	\$31.79	\$88.34
Cement Finishers & Plasterers	5/1/2022		\$38.57	\$32.39	\$70.96
Cement Masons	5/1/2024		\$46.70	\$32.46	\$79.16
Cement Masons	5/1/2025		\$48.70	\$32.46	\$81.16
Dockbuilder, Pile Drivers	5/1/2026		\$56.98	\$37.99	\$94.97
Dockbuilder/Pile Driver Diver	5/1/2026		\$66.54	\$41.74	\$108.28
Dockbuilder/pile driver tender	5/1/2026		\$56.98	\$37.99	\$94.97
Drywall Finisher	5/1/2025		\$40.14	\$32.35	\$72.49
Drywall Finisher	5/1/2026		\$41.10	\$32.99	\$74.09
Electricians	5/1/2025		\$58.63	\$47.28	\$105.91
Electricians	5/1/2026		\$62.41	\$48.50	\$110.91
Electricians	5/1/2027		\$66.53	\$50.63	\$117.16
Electricians	5/1/2028		\$70.83	\$52.83	\$123.66
Elevator Constructor	1/1/2025		\$71.85	\$45.77	\$117.62
Elevator Constructor	1/1/2026		\$74.86	\$46.86	\$121.72
Floor Coverer	5/1/2025		\$51.67	\$31.69	\$83.36
Floor Coverer	5/1/2026		\$52.84	\$32.86	\$85.70
Glazier	5/1/2025		\$49.96	\$38.34	\$88.30
Glazier	5/1/2026		\$51.30	\$39.37	\$90.67
Interior Finish	5/1/2023		\$34.60	\$25.80	\$60.40
Iron Workers (Bridge, Structural, Ornamental, Precast)	7/1/2024		\$53.20	\$45.01	\$98.21
Iron Workers (Riggers)	7/1/2025		\$44.77	\$36.27	\$81.04
Iron Workers (Riggers)	7/1/2026		\$48.84	\$36.52	\$85.36
Iron Workers (Rodman/Reinforcing)	7/1/2024		\$47.70	\$34.77	\$82.47
Iron Workers (Rodman/Reinforcing)	7/1/2025		\$47.80	\$36.65	\$84.45
Iron Workers (Rodman/Reinforcing)	7/1/2026		\$52.39	\$36.90	\$89.29
Laborers (Class 01 - See notes)	5/1/2025		\$37.25	\$26.10	\$63.35
Laborers (Class 02 - See notes)	5/1/2025		\$41.00	\$27.70	\$68.70
Laborers (Class 03 - See notes)	5/1/2025		\$37.67	\$26.28	\$63.95
Laborers (Class 04 - See notes)	5/1/2025		\$37.67	\$26.28	\$63.95
Laborers (Class 05 - See notes)	5/1/2025		\$37.25	\$26.10	\$63.35
Landscape Laborer	5/1/2025		\$32.15	\$24.30	\$56.45

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08383 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Marble Finisher	5/1/2025		\$41.17	\$30.75	\$71.92
Marble Finisher	5/1/2026		\$42.07	\$31.85	\$73.92
Marble Mason	5/1/2023		\$47.20	\$31.95	\$79.15
Marble Setter	5/1/2026		\$51.50	\$33.80	\$85.30
Mason Tender, Cement	5/1/2023		\$35.02	\$25.98	\$61.00
Millwright	5/1/2025		\$57.39	\$35.81	\$93.20
Millwright	5/1/2026		\$60.20	\$35.81	\$96.01
Operators (Building, Class 01 - See Notes)	5/1/2025		\$54.52	\$34.49	\$89.01
Operators (Building, Class 01 - See Notes)	5/1/2026		\$55.67	\$35.34	\$91.01
Operators (Building, Class 01A - See Notes)	5/1/2025		\$57.52	\$35.38	\$92.90
Operators (Building, Class 01A - See Notes)	5/1/2026		\$58.68	\$36.22	\$94.90
Operators (Building, Class 02 - See Notes)	5/1/2025		\$54.27	\$34.42	\$88.69
Operators (Building, Class 02 - See Notes)	5/1/2026		\$55.43	\$35.26	\$90.69
Operators (Building, Class 02A - See Notes)	5/1/2025		\$57.29	\$35.29	\$92.58
Operators (Building, Class 02A - See Notes)	5/1/2026		\$58.44	\$36.14	\$94.58
Operators (Building, Class 03 - See Notes)	5/1/2025		\$50.18	\$33.22	\$83.40
Operators (Building, Class 03 - See Notes)	5/1/2026		\$51.34	\$34.06	\$85.40
Operators (Building, Class 04 - See Notes)	5/1/2025		\$49.88	\$33.13	\$83.01
Operators (Building, Class 04 - See Notes)	5/1/2026		\$51.04	\$33.97	\$85.01
Operators (Building, Class 05 - See Notes)	5/1/2025		\$48.16	\$32.62	\$80.78
Operators (Building, Class 05 - See Notes)	5/1/2026		\$49.32	\$33.46	\$82.78
Operators (Building, Class 06 - See Notes)	5/1/2025		\$47.17	\$32.33	\$79.50
Operators (Building, Class 06 - See Notes)	5/1/2026		\$48.34	\$33.16	\$81.50
Operators (Building, Class 07A- See Notes)	5/1/2025		\$66.26	\$39.55	\$105.81
Operators (Building, Class 07A- See Notes)	5/1/2026		\$67.73	\$40.48	\$108.21
Operators (Building, Class 07B- See Notes)	5/1/2025		\$65.97	\$39.46	\$105.43
Operators (Building, Class 07B- See Notes)	5/1/2026		\$67.44	\$40.39	\$107.83
Painters Class 1 (see notes)	5/1/2025		\$44.38	\$34.55	\$78.93
Painters Class 1 (see notes)	5/1/2026		\$45.71	\$35.22	\$80.93
Painters - Line Stripping	12/1/2024		\$44.12	\$27.91	\$72.03
Painters - Line Stripping	12/1/2025		\$45.12	\$29.41	\$74.53
Painters Class 4 (see notes)	5/1/2025		\$46.47	\$34.55	\$81.02
Painters Class 4 (see notes)	5/1/2026		\$48.45	\$35.22	\$83.67
Plasterers	5/1/2024		\$39.88	\$33.08	\$72.96
plumber	5/1/2025		\$70.53	\$39.46	\$109.99
plumber	5/1/2026		\$73.73	\$40.36	\$114.09
Pointers, Caulkers, Cleaners	5/1/2025		\$51.35	\$31.80	\$83.15
Pointers, Caulkers, Cleaners	5/1/2026		\$53.35	\$32.30	\$85.65
Roofers (Composition)	5/1/2025		\$46.03	\$34.77	\$80.80
Roofers (Composition)	5/1/2026		\$47.53	\$35.22	\$82.75
Roofers (Shingle)	5/1/2024		\$34.35	\$22.20	\$56.55
Roofers (Slate & Tile)	5/1/2024		\$37.35	\$22.20	\$59.55
Sheet Metal Workers	5/1/2025		\$62.62	\$52.17	\$114.79
Sheet Metal Workers	5/1/2026		\$65.06	\$54.48	\$119.54

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08383 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Sign Makers and Hangars	7/15/2025		\$33.48	\$26.41	\$59.89
Sign Makers and Hangars	7/15/2026		\$36.38	\$25.01	\$61.39
Sprinklerfitters	1/1/2023		\$62.23	\$31.99	\$94.22
Sprinklerfitters	5/1/2025		\$70.37	\$34.85	\$105.22
Steamfitters	5/1/2024		\$70.32	\$43.09	\$113.41
Steamfitters	5/1/2025		\$72.52	\$44.89	\$117.41
Stone Masons	5/1/2025		\$50.00	\$32.80	\$82.80
Stone Masons	5/1/2026		\$51.50	\$33.80	\$85.30
Terrazzo Finisher	5/1/2025		\$45.61	\$29.41	\$75.02
Terrazzo Finisher	5/1/2026		\$47.78	\$29.61	\$77.39
Terrazzo Grinder	5/1/2025		\$45.88	\$29.41	\$75.29
Terrazzo Grinder	5/1/2026		\$47.78	\$29.61	\$77.39
Terrazzo Mechanics	5/1/2025		\$52.21	\$31.26	\$83.47
Terrazzo Mechanics	5/1/2026		\$53.36	\$32.61	\$85.97
Tile Finisher	5/1/2025		\$41.17	\$30.75	\$71.92
Tile Finisher	5/1/2026		\$42.07	\$31.85	\$73.92
Tile Setter	5/1/2025		\$52.21	\$31.26	\$83.47
Tile Setter	5/1/2026		\$53.36	\$32.61	\$85.97
Truckdriver class 1(see notes)	5/1/2024		\$36.79	\$22.54	\$59.33
Truckdriver class 1(see notes)	5/1/2026		\$38.57	\$23.87	\$62.44
Truckdriver class 2 (see notes)	5/1/2024		\$36.89	\$22.54	\$59.43
Truckdriver class 2 (see notes)	5/1/2026		\$38.67	\$23.87	\$62.54
Truckdriver class 3 (see notes)	5/1/2026		\$38.92	\$23.87	\$62.79
Window Film / Tint Installer	6/1/2025		\$27.42	\$15.13	\$42.55

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08383 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Bricklayer	5/1/2025		\$50.00	\$32.57	\$82.57
Bricklayer	5/1/2026		\$51.15	\$34.92	\$86.07
Carpenter - Chief of Party (Surveying & Layout)	5/1/2025		\$65.96	\$30.09	\$96.05
Carpenter - Chief of Party (Surveying & Layout)	5/1/2026		\$67.52	\$30.44	\$97.96
Carpenter - Instrument Person (Surveying & Layout)	5/1/2025		\$58.39	\$29.06	\$87.45
Carpenter - Instrument Person (Surveying & Layout)	5/1/2026		\$60.09	\$29.06	\$89.15
Carpenter - Rodman (Surveying & Layout)	5/1/2025		\$45.88	\$23.19	\$69.07
Carpenter - Rodman (Surveying & Layout)	5/1/2026		\$46.97	\$23.54	\$70.51
Carpenter	5/1/2025		\$57.36	\$30.09	\$87.45
Carpenter	5/1/2026		\$58.71	\$30.44	\$89.15
Cement Masons	5/1/2023		\$43.20	\$32.91	\$76.11
Cement Masons	5/1/2025		\$46.55	\$32.66	\$79.21
Dockbuilder, Pile Drivers	5/1/2026		\$56.98	\$37.99	\$94.97
Dockbuilder/Pile Driver Diver	5/1/2026		\$61.88	\$45.47	\$107.35
Dockbuilder/pile driver tender	5/1/2026		\$56.98	\$37.99	\$94.97
Electric Lineman	6/3/2024		\$62.07	\$33.96	\$96.03
Electric Lineman	6/2/2025		\$65.10	\$34.45	\$99.55
Iron Workers (Bridge, Structural, Ornamental, Precast)	7/1/2024		\$53.20	\$45.01	\$98.21
Iron Workers (Riggers)	7/1/2023		\$42.53	\$34.14	\$76.67
Iron Workers (Rodman/Reinforcing)	7/1/2023		\$45.70	\$34.77	\$80.47
Laborers (Class 01 - See notes)	5/1/2025		\$40.20	\$27.80	\$68.00
Laborers (Class 01 - See notes)	5/1/2026		\$41.65	\$27.90	\$69.55
Laborers (Class 02 - See notes)	5/1/2025		\$40.40	\$27.80	\$68.20
Laborers (Class 02 - See notes)	5/1/2026		\$41.85	\$27.90	\$69.75
Laborers (Class 03 - See notes)	5/1/2025		\$40.40	\$27.80	\$68.20
Laborers (Class 03 - See notes)	5/1/2026		\$41.85	\$27.90	\$69.75
Laborers (Class 04 - See notes)	5/1/2025		\$35.00	\$27.80	\$62.80
Laborers (Class 04 - See notes)	5/1/2026		\$36.45	\$27.90	\$64.35
Laborers (Class 05 - See notes)	5/1/2025		\$41.05	\$27.80	\$68.85
Laborers (Class 05 - See notes)	5/1/2026		\$42.50	\$27.90	\$70.40
Laborers (Class 06 - See notes)	5/1/2025		\$41.10	\$27.80	\$68.90
Laborers (Class 06 - See notes)	5/1/2026		\$42.55	\$27.90	\$70.45
Laborers (Class 07 - See notes)	5/1/2025		\$40.95	\$27.80	\$68.75
Laborers (Class 07 - See notes)	5/1/2026		\$42.40	\$27.90	\$70.30
Laborers (Class 08 - See notes)	5/1/2025		\$40.70	\$27.80	\$68.50
Laborers (Class 08 - See notes)	5/1/2026		\$42.15	\$27.90	\$70.05
Laborers (Class 09 - See notes)	5/1/2025		\$40.55	\$27.80	\$68.35
Laborers (Class 09 - See notes)	5/1/2026		\$42.00	\$27.90	\$69.90
Laborers (Class 10- See notes)	5/1/2025		\$40.70	\$27.80	\$68.50
Laborers (Class 10- See notes)	5/1/2026		\$42.15	\$27.90	\$70.05
Laborers (Class 11 -See Notes)	5/1/2025		\$40.60	\$27.80	\$68.40
Laborers (Class 11 -See Notes)	5/1/2026		\$42.05	\$27.90	\$69.95
Laborers (Class 12 -See Notes)	5/1/2025		\$42.30	\$27.80	\$70.10
Laborers (Class 12 -See Notes)	5/1/2026		\$42.85	\$27.90	\$70.75

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08383 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Laborers (Class 13 -See Notes)	5/1/2025		\$44.33	\$27.80	\$72.13
Laborers (Class 13 -See Notes)	5/1/2026		\$45.78	\$27.90	\$73.68
Laborers (Class 14 -See Notes)	5/1/2025		\$40.90	\$27.80	\$68.70
Laborers (Class 14 -See Notes)	5/1/2026		\$41.90	\$27.90	\$69.80
Laborers Utility (PGW ONLY) (Flagperson)	5/1/2025		\$34.07	\$19.73	\$53.80
Laborers Utility (PGW ONLY) (Flagperson)	5/1/2026		\$35.52	\$19.83	\$55.35
Laborers Utility (PGW ONLY)	5/1/2024		\$39.70	\$19.63	\$59.33
Laborers Utility (PGW ONLY)	5/1/2025		\$41.10	\$19.73	\$60.83
Laborers Utility (PGW ONLY)	5/1/2026		\$42.55	\$19.83	\$62.38
Landscape Laborer	5/1/2024		\$30.28	\$24.05	\$54.33
Landscape Laborer	5/1/2025		\$31.73	\$24.15	\$55.88
Millwright	5/1/2025		\$57.39	\$35.81	\$93.20
Millwright	5/1/2026		\$60.20	\$35.81	\$96.01
Operators Class 01 - See Notes (Building, Heavy, Highway)	5/1/2025		\$54.52	\$34.49	\$89.01
Operators Class 01 - See Notes (Building, Heavy, Highway)	5/1/2026		\$55.67	\$35.34	\$91.01
Operators Class 01a - See Notes (Building, Heavy, Highway)	5/1/2025		\$57.52	\$35.38	\$92.90
Operators Class 01a - See Notes (Building, Heavy, Highway)	5/1/2026		\$58.68	\$36.22	\$94.90
Operators Class 02 - See Notes (Building, Heavy, Highway)	5/1/2025		\$54.27	\$34.42	\$88.69
Operators Class 02 - See Notes (Building, Heavy, Highway)	5/1/2026		\$55.43	\$35.26	\$90.69
Operators Class 02a - See Notes (Building, Heavy, Highway)	5/1/2025		\$57.29	\$35.29	\$92.58
Operators Class 02a - See Notes (Building, Heavy, Highway)	5/1/2026		\$58.44	\$36.14	\$94.58
Operators Class 03 - See Notes (Building, Heavy, Highway)	5/1/2025		\$50.18	\$33.22	\$83.40
Operators Class 03 - See Notes (Building, Heavy, Highway)	5/1/2026		\$51.34	\$34.06	\$85.40
Operators Class 04 - See Notes (Building, Heavy, Highway)	5/1/2025		\$49.88	\$33.13	\$83.01
Operators Class 04 - See Notes (Building, Heavy, Highway)	5/1/2026		\$51.04	\$33.97	\$85.01
Operators Class 05 - See Notes (Building, Heavy, Highway)	5/1/2025		\$48.16	\$32.62	\$80.78
Operators Class 05 - See Notes (Building, Heavy, Highway)	5/1/2026		\$49.32	\$33.46	\$82.78
Operators Class 06 - See Notes (Building, Heavy, Highway)	5/1/2025		\$47.17	\$32.33	\$79.50
Operators Class 06 - See Notes (Building, Heavy, Highway)	5/1/2026		\$48.34	\$33.16	\$81.50
Operators Class 07 (A) - See Notes (Building, Heavy, Highway)	5/1/2025		\$66.26	\$39.55	\$105.81
Operators Class 07 (A) - See Notes (Building, Heavy, Highway)	5/1/2026		\$67.73	\$40.48	\$108.21
Operators Class 07 (B) - See Notes (Building, Heavy, Highway)	5/1/2025		\$65.97	\$39.46	\$105.43

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08383 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Operators Class 07 (B) - See Notes (Building, Heavy, Highway)	5/1/2026		\$67.44	\$40.39	\$107.83
Painters - Line Stripping	12/1/2024		\$44.12	\$27.91	\$72.03
Painters - Line Stripping	12/1/2025		\$45.12	\$29.41	\$74.53
Painters Class 2 (see notes)	2/1/2025		\$50.85	\$33.91	\$84.76
Painters Class 2 (see notes)	2/1/2026		\$51.61	\$35.00	\$86.61
Painters Class 3 (see notes)	2/1/2025		\$61.81	\$33.95	\$95.76
Painters Class 3 (see notes)	2/1/2026		\$62.57	\$35.04	\$97.61
Pointers, Caulkers, Cleaners	5/1/2025		\$51.35	\$31.80	\$83.15
Steamfitters (Heavy and Highway - Gas Distribution)	5/1/2025		\$68.89	\$44.73	\$113.62
Steamfitters	5/1/2018		\$56.37	\$34.39	\$90.76
Truckdriver class 1(see notes)	5/1/2024		\$36.64	\$22.54	\$59.18
Truckdriver class 1(see notes)	5/1/2026		\$38.42	\$23.87	\$62.29
Truckdriver class 2 (see notes)	5/1/2024		\$36.74	\$22.54	\$59.28
Truckdriver class 2 (see notes)	5/1/2026		\$38.52	\$23.87	\$62.39
Truckdriver class 3 (see notes)	5/1/2026		\$38.77	\$23.87	\$62.64

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project Name:	HVAC Renovations and Upgrades at Valley Forge Middle School
General Description:	Replacement of HV mechanical unit with associated electrical and general trades work.
Project Locality	105 W. Walker Road, Wayne, PA
Awarding Agency:	Tredyffrin Easttown School District
Contract Award Date:	11/23/2026
Serial Number:	26-08387
Project Classification:	Building
Determination Date:	9/17/2026
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: 26-08387 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Asbestos & Insulation Workers	5/1/2025		\$60.84	\$48.71	\$109.55
Asbestos & Insulation Workers	5/1/2026		\$64.51	\$50.26	\$114.77
Boilermakers	3/1/2018		\$45.89	\$33.73	\$79.62
Bricklayer	5/1/2025		\$50.00	\$32.57	\$82.57
Bricklayer	5/1/2026		\$51.15	\$34.92	\$86.07
Carpenter - Chief of Party (Surveying & Layout)	5/1/2025		\$54.59	\$29.02	\$83.61
Carpenter - Instrument Person (Surveying & Layout)	5/1/2025		\$47.47	\$29.02	\$76.49
Carpenter - Rodman (Surveying & Layout)	5/1/2025		\$23.74	\$20.62	\$44.36
Carpenters	5/1/2026		\$48.55	\$30.39	\$78.94
Carpenters	5/1/2027		\$50.46	\$30.74	\$81.20
Carpenters	5/1/2028		\$52.43	\$31.09	\$83.52
Carpenters	5/1/2029		\$54.46	\$31.44	\$85.90
Carpenters	5/1/2030		\$56.55	\$31.79	\$88.34
Cement Finishers & Plasterers	5/1/2022		\$38.57	\$32.39	\$70.96
Cement Masons	5/1/2024		\$46.70	\$32.46	\$79.16
Cement Masons	5/1/2025		\$48.70	\$32.46	\$81.16
Dockbuilder, Pile Drivers	5/1/2026		\$56.98	\$37.99	\$94.97
Dockbuilder/Pile Driver Diver	5/1/2026		\$66.54	\$41.74	\$108.28
Dockbuilder/pile driver tender	5/1/2026		\$56.98	\$37.99	\$94.97
Drywall Finisher	5/1/2025		\$40.14	\$32.35	\$72.49
Drywall Finisher	5/1/2026		\$41.10	\$32.99	\$74.09
Electricians	5/1/2025		\$58.63	\$47.28	\$105.91
Electricians	5/1/2026		\$62.41	\$48.50	\$110.91
Electricians	5/1/2027		\$66.53	\$50.63	\$117.16
Electricians	5/1/2028		\$70.83	\$52.83	\$123.66
Elevator Constructor	1/1/2025		\$71.85	\$45.77	\$117.62
Elevator Constructor	1/1/2026		\$74.86	\$46.86	\$121.72
Floor Coverer	5/1/2025		\$51.67	\$31.69	\$83.36
Floor Coverer	5/1/2026		\$52.84	\$32.86	\$85.70
Glazier	5/1/2025		\$49.96	\$38.34	\$88.30
Glazier	5/1/2026		\$51.30	\$39.37	\$90.67
Interior Finish	5/1/2023		\$34.60	\$25.80	\$60.40
Iron Workers (Bridge, Structural, Ornamental, Precast)	7/1/2024		\$53.20	\$45.01	\$98.21
Iron Workers (Riggers)	7/1/2025		\$44.77	\$36.27	\$81.04
Iron Workers (Riggers)	7/1/2026		\$48.84	\$36.52	\$85.36
Iron Workers (Rodman/Reinforcing)	7/1/2024		\$47.70	\$34.77	\$82.47
Iron Workers (Rodman/Reinforcing)	7/1/2025		\$47.80	\$36.65	\$84.45
Iron Workers (Rodman/Reinforcing)	7/1/2026		\$52.39	\$36.90	\$89.29
Laborers (Class 01 - See notes)	5/1/2025		\$37.25	\$26.10	\$63.35
Laborers (Class 02 - See notes)	5/1/2025		\$41.00	\$27.70	\$68.70
Laborers (Class 03 - See notes)	5/1/2025		\$37.67	\$26.28	\$63.95
Laborers (Class 04 - See notes)	5/1/2025		\$37.67	\$26.28	\$63.95
Laborers (Class 05 - See notes)	5/1/2025		\$37.25	\$26.10	\$63.35
Landscape Laborer	5/1/2025		\$32.15	\$24.30	\$56.45

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08387 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Marble Finisher	5/1/2025		\$41.17	\$30.75	\$71.92
Marble Finisher	5/1/2026		\$42.07	\$31.85	\$73.92
Marble Mason	5/1/2023		\$47.20	\$31.95	\$79.15
Marble Setter	5/1/2026		\$51.50	\$33.80	\$85.30
Mason Tender, Cement	5/1/2023		\$35.02	\$25.98	\$61.00
Millwright	5/1/2025		\$57.39	\$35.81	\$93.20
Millwright	5/1/2026		\$60.20	\$35.81	\$96.01
Operators (Building, Class 01 - See Notes)	5/1/2025		\$54.52	\$34.49	\$89.01
Operators (Building, Class 01 - See Notes)	5/1/2026		\$55.67	\$35.34	\$91.01
Operators (Building, Class 01A - See Notes)	5/1/2025		\$57.52	\$35.38	\$92.90
Operators (Building, Class 01A - See Notes)	5/1/2026		\$58.68	\$36.22	\$94.90
Operators (Building, Class 02 - See Notes)	5/1/2025		\$54.27	\$34.42	\$88.69
Operators (Building, Class 02 - See Notes)	5/1/2026		\$55.43	\$35.26	\$90.69
Operators (Building, Class 02A - See Notes)	5/1/2025		\$57.29	\$35.29	\$92.58
Operators (Building, Class 02A - See Notes)	5/1/2026		\$58.44	\$36.14	\$94.58
Operators (Building, Class 03 - See Notes)	5/1/2025		\$50.18	\$33.22	\$83.40
Operators (Building, Class 03 - See Notes)	5/1/2026		\$51.34	\$34.06	\$85.40
Operators (Building, Class 04 - See Notes)	5/1/2025		\$49.88	\$33.13	\$83.01
Operators (Building, Class 04 - See Notes)	5/1/2026		\$51.04	\$33.97	\$85.01
Operators (Building, Class 05 - See Notes)	5/1/2025		\$48.16	\$32.62	\$80.78
Operators (Building, Class 05 - See Notes)	5/1/2026		\$49.32	\$33.46	\$82.78
Operators (Building, Class 06 - See Notes)	5/1/2025		\$47.17	\$32.33	\$79.50
Operators (Building, Class 06 - See Notes)	5/1/2026		\$48.34	\$33.16	\$81.50
Operators (Building, Class 07A- See Notes)	5/1/2025		\$66.26	\$39.55	\$105.81
Operators (Building, Class 07A- See Notes)	5/1/2026		\$67.73	\$40.48	\$108.21
Operators (Building, Class 07B- See Notes)	5/1/2025		\$65.97	\$39.46	\$105.43
Operators (Building, Class 07B- See Notes)	5/1/2026		\$67.44	\$40.39	\$107.83
Painters Class 1 (see notes)	5/1/2025		\$44.38	\$34.55	\$78.93
Painters Class 1 (see notes)	5/1/2026		\$45.71	\$35.22	\$80.93
Painters - Line Stripping	12/1/2024		\$44.12	\$27.91	\$72.03
Painters - Line Stripping	12/1/2025		\$45.12	\$29.41	\$74.53
Painters Class 4 (see notes)	5/1/2025		\$46.47	\$34.55	\$81.02
Painters Class 4 (see notes)	5/1/2026		\$48.45	\$35.22	\$83.67
Plasterers	5/1/2024		\$39.88	\$33.08	\$72.96
plumber	5/1/2025		\$70.53	\$39.46	\$109.99
plumber	5/1/2026		\$73.73	\$40.36	\$114.09
Pointers, Caulkers, Cleaners	5/1/2025		\$51.35	\$31.80	\$83.15
Pointers, Caulkers, Cleaners	5/1/2026		\$53.35	\$32.30	\$85.65
Roofers (Composition)	5/1/2025		\$46.03	\$34.77	\$80.80
Roofers (Composition)	5/1/2026		\$47.53	\$35.22	\$82.75
Roofers (Shingle)	5/1/2024		\$34.35	\$22.20	\$56.55
Roofers (Slate & Tile)	5/1/2024		\$37.35	\$22.20	\$59.55
Sheet Metal Workers	5/1/2025		\$62.62	\$52.17	\$114.79
Sheet Metal Workers	5/1/2026		\$65.06	\$54.48	\$119.54

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08387 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Sign Makers and Hangars	7/15/2025		\$33.48	\$26.41	\$59.89
Sign Makers and Hangars	7/15/2026		\$36.38	\$25.01	\$61.39
Sprinklerfitters	1/1/2023		\$62.23	\$31.99	\$94.22
Sprinklerfitters	5/1/2025		\$70.37	\$34.85	\$105.22
Steamfitters	5/1/2024		\$70.32	\$43.09	\$113.41
Steamfitters	5/1/2025		\$72.52	\$44.89	\$117.41
Stone Masons	5/1/2025		\$50.00	\$32.80	\$82.80
Stone Masons	5/1/2026		\$51.50	\$33.80	\$85.30
Terrazzo Finisher	5/1/2025		\$45.61	\$29.41	\$75.02
Terrazzo Finisher	5/1/2026		\$47.78	\$29.61	\$77.39
Terrazzo Grinder	5/1/2025		\$45.88	\$29.41	\$75.29
Terrazzo Grinder	5/1/2026		\$47.78	\$29.61	\$77.39
Terrazzo Mechanics	5/1/2025		\$52.21	\$31.26	\$83.47
Terrazzo Mechanics	5/1/2026		\$53.36	\$32.61	\$85.97
Tile Finisher	5/1/2025		\$41.17	\$30.75	\$71.92
Tile Finisher	5/1/2026		\$42.07	\$31.85	\$73.92
Tile Setter	5/1/2025		\$52.21	\$31.26	\$83.47
Tile Setter	5/1/2026		\$53.36	\$32.61	\$85.97
Truckdriver class 1(see notes)	5/1/2024		\$36.79	\$22.54	\$59.33
Truckdriver class 1(see notes)	5/1/2026		\$38.57	\$23.87	\$62.44
Truckdriver class 2 (see notes)	5/1/2024		\$36.89	\$22.54	\$59.43
Truckdriver class 2 (see notes)	5/1/2026		\$38.67	\$23.87	\$62.54
Truckdriver class 3 (see notes)	5/1/2026		\$38.92	\$23.87	\$62.79
Window Film / Tint Installer	6/1/2025		\$27.42	\$15.13	\$42.55

BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project: 26-08387 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Bricklayer	5/1/2025		\$50.00	\$32.57	\$82.57
Bricklayer	5/1/2026		\$51.15	\$34.92	\$86.07
Carpenter - Chief of Party (Surveying & Layout)	5/1/2025		\$65.96	\$30.09	\$96.05
Carpenter - Chief of Party (Surveying & Layout)	5/1/2026		\$67.52	\$30.44	\$97.96
Carpenter - Instrument Person (Surveying & Layout)	5/1/2025		\$58.39	\$29.06	\$87.45
Carpenter - Instrument Person (Surveying & Layout)	5/1/2026		\$60.09	\$29.06	\$89.15
Carpenter - Rodman (Surveying & Layout)	5/1/2025		\$45.88	\$23.19	\$69.07
Carpenter - Rodman (Surveying & Layout)	5/1/2026		\$46.97	\$23.54	\$70.51
Carpenter	5/1/2025		\$57.36	\$30.09	\$87.45
Carpenter	5/1/2026		\$58.71	\$30.44	\$89.15
Cement Masons	5/1/2023		\$43.20	\$32.91	\$76.11
Cement Masons	5/1/2025		\$46.55	\$32.66	\$79.21
Dockbuilder, Pile Drivers	5/1/2026		\$56.98	\$37.99	\$94.97
Dockbuilder/Pile Driver Diver	5/1/2026		\$61.88	\$45.47	\$107.35
Dockbuilder/pile driver tender	5/1/2026		\$56.98	\$37.99	\$94.97
Electric Lineman	6/3/2024		\$62.07	\$33.96	\$96.03
Electric Lineman	6/2/2025		\$65.10	\$34.45	\$99.55
Iron Workers (Bridge, Structural, Ornamental, Precast)	7/1/2024		\$53.20	\$45.01	\$98.21
Iron Workers (Riggers)	7/1/2023		\$42.53	\$34.14	\$76.67
Iron Workers (Rodman/Reinforcing)	7/1/2023		\$45.70	\$34.77	\$80.47
Laborers (Class 01 - See notes)	5/1/2025		\$40.20	\$27.80	\$68.00
Laborers (Class 01 - See notes)	5/1/2026		\$41.65	\$27.90	\$69.55
Laborers (Class 02 - See notes)	5/1/2025		\$40.40	\$27.80	\$68.20
Laborers (Class 02 - See notes)	5/1/2026		\$41.85	\$27.90	\$69.75
Laborers (Class 03 - See notes)	5/1/2025		\$40.40	\$27.80	\$68.20
Laborers (Class 03 - See notes)	5/1/2026		\$41.85	\$27.90	\$69.75
Laborers (Class 04 - See notes)	5/1/2025		\$35.00	\$27.80	\$62.80
Laborers (Class 04 - See notes)	5/1/2026		\$36.45	\$27.90	\$64.35
Laborers (Class 05 - See notes)	5/1/2025		\$41.05	\$27.80	\$68.85
Laborers (Class 05 - See notes)	5/1/2026		\$42.50	\$27.90	\$70.40
Laborers (Class 06 - See notes)	5/1/2025		\$41.10	\$27.80	\$68.90
Laborers (Class 06 - See notes)	5/1/2026		\$42.55	\$27.90	\$70.45
Laborers (Class 07 - See notes)	5/1/2025		\$40.95	\$27.80	\$68.75
Laborers (Class 07 - See notes)	5/1/2026		\$42.40	\$27.90	\$70.30
Laborers (Class 08 - See notes)	5/1/2025		\$40.70	\$27.80	\$68.50
Laborers (Class 08 - See notes)	5/1/2026		\$42.15	\$27.90	\$70.05
Laborers (Class 09 - See notes)	5/1/2025		\$40.55	\$27.80	\$68.35
Laborers (Class 09 - See notes)	5/1/2026		\$42.00	\$27.90	\$69.90
Laborers (Class 10- See notes)	5/1/2025		\$40.70	\$27.80	\$68.50
Laborers (Class 10- See notes)	5/1/2026		\$42.15	\$27.90	\$70.05
Laborers (Class 11 -See Notes)	5/1/2025		\$40.60	\$27.80	\$68.40
Laborers (Class 11 -See Notes)	5/1/2026		\$42.05	\$27.90	\$69.95
Laborers (Class 12 -See Notes)	5/1/2025		\$42.30	\$27.80	\$70.10
Laborers (Class 12 -See Notes)	5/1/2026		\$42.85	\$27.90	\$70.75

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08387 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Laborers (Class 13 -See Notes)	5/1/2025		\$44.33	\$27.80	\$72.13
Laborers (Class 13 -See Notes)	5/1/2026		\$45.78	\$27.90	\$73.68
Laborers (Class 14 -See Notes)	5/1/2025		\$40.90	\$27.80	\$68.70
Laborers (Class 14 -See Notes)	5/1/2026		\$41.90	\$27.90	\$69.80
Laborers Utility (PGW ONLY) (Flagperson)	5/1/2025		\$34.07	\$19.73	\$53.80
Laborers Utility (PGW ONLY) (Flagperson)	5/1/2026		\$35.52	\$19.83	\$55.35
Laborers Utility (PGW ONLY)	5/1/2024		\$39.70	\$19.63	\$59.33
Laborers Utility (PGW ONLY)	5/1/2025		\$41.10	\$19.73	\$60.83
Laborers Utility (PGW ONLY)	5/1/2026		\$42.55	\$19.83	\$62.38
Landscape Laborer	5/1/2024		\$30.28	\$24.05	\$54.33
Landscape Laborer	5/1/2025		\$31.73	\$24.15	\$55.88
Millwright	5/1/2025		\$57.39	\$35.81	\$93.20
Millwright	5/1/2026		\$60.20	\$35.81	\$96.01
Operators Class 01 - See Notes (Building, Heavy, Highway)	5/1/2025		\$54.52	\$34.49	\$89.01
Operators Class 01 - See Notes (Building, Heavy, Highway)	5/1/2026		\$55.67	\$35.34	\$91.01
Operators Class 01a - See Notes (Building, Heavy, Highway)	5/1/2025		\$57.52	\$35.38	\$92.90
Operators Class 01a - See Notes (Building, Heavy, Highway)	5/1/2026		\$58.68	\$36.22	\$94.90
Operators Class 02 - See Notes (Building, Heavy, Highway)	5/1/2025		\$54.27	\$34.42	\$88.69
Operators Class 02 - See Notes (Building, Heavy, Highway)	5/1/2026		\$55.43	\$35.26	\$90.69
Operators Class 02a - See Notes (Building, Heavy, Highway)	5/1/2025		\$57.29	\$35.29	\$92.58
Operators Class 02a - See Notes (Building, Heavy, Highway)	5/1/2026		\$58.44	\$36.14	\$94.58
Operators Class 03 - See Notes (Building, Heavy, Highway)	5/1/2025		\$50.18	\$33.22	\$83.40
Operators Class 03 - See Notes (Building, Heavy, Highway)	5/1/2026		\$51.34	\$34.06	\$85.40
Operators Class 04 - See Notes (Building, Heavy, Highway)	5/1/2025		\$49.88	\$33.13	\$83.01
Operators Class 04 - See Notes (Building, Heavy, Highway)	5/1/2026		\$51.04	\$33.97	\$85.01
Operators Class 05 - See Notes (Building, Heavy, Highway)	5/1/2025		\$48.16	\$32.62	\$80.78
Operators Class 05 - See Notes (Building, Heavy, Highway)	5/1/2026		\$49.32	\$33.46	\$82.78
Operators Class 06 - See Notes (Building, Heavy, Highway)	5/1/2025		\$47.17	\$32.33	\$79.50
Operators Class 06 - See Notes (Building, Heavy, Highway)	5/1/2026		\$48.34	\$33.16	\$81.50
Operators Class 07 (A) - See Notes (Building, Heavy, Highway)	5/1/2025		\$66.26	\$39.55	\$105.81
Operators Class 07 (A) - See Notes (Building, Heavy, Highway)	5/1/2026		\$67.73	\$40.48	\$108.21
Operators Class 07 (B) - See Notes (Building, Heavy, Highway)	5/1/2025		\$65.97	\$39.46	\$105.43

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08387 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Operators Class 07 (B) - See Notes (Building, Heavy, Highway)	5/1/2026		\$67.44	\$40.39	\$107.83
Painters - Line Stripping	12/1/2024		\$44.12	\$27.91	\$72.03
Painters - Line Stripping	12/1/2025		\$45.12	\$29.41	\$74.53
Painters Class 2 (see notes)	2/1/2025		\$50.85	\$33.91	\$84.76
Painters Class 2 (see notes)	2/1/2026		\$51.61	\$35.00	\$86.61
Painters Class 3 (see notes)	2/1/2025		\$61.81	\$33.95	\$95.76
Painters Class 3 (see notes)	2/1/2026		\$62.57	\$35.04	\$97.61
Pointers, Caulkers, Cleaners	5/1/2025		\$51.35	\$31.80	\$83.15
Steamfitters (Heavy and Highway - Gas Distribution)	5/1/2025		\$68.89	\$44.73	\$113.62
Steamfitters	5/1/2018		\$56.37	\$34.39	\$90.76
Truckdriver class 1(see notes)	5/1/2024		\$36.64	\$22.54	\$59.18
Truckdriver class 1(see notes)	5/1/2026		\$38.42	\$23.87	\$62.29
Truckdriver class 2 (see notes)	5/1/2024		\$36.74	\$22.54	\$59.28
Truckdriver class 2 (see notes)	5/1/2026		\$38.52	\$23.87	\$62.39
Truckdriver class 3 (see notes)	5/1/2026		\$38.77	\$23.87	\$62.64

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project Name:	HVAC Renovations and Upgrades at Conestoga High School
General Description:	Replacement of AHU units, and exhaust fans with associated electrical and general trades work. Replacement of library electrical panels.
Project Locality	200 Irish Road, Berwyn, PA 193
Awarding Agency:	Tredyffrin Easttown School District
Contract Award Date:	11/23/2026
Serial Number:	26-08388
Project Classification:	Building
Determination Date:	9/17/2026
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: 26-08388 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Asbestos & Insulation Workers	5/1/2025		\$60.84	\$48.71	\$109.55
Asbestos & Insulation Workers	5/1/2026		\$64.51	\$50.26	\$114.77
Boilermakers	3/1/2018		\$45.89	\$33.73	\$79.62
Bricklayer	5/1/2025		\$50.00	\$32.57	\$82.57
Bricklayer	5/1/2026		\$51.15	\$34.92	\$86.07
Carpenter - Chief of Party (Surveying & Layout)	5/1/2025		\$54.59	\$29.02	\$83.61
Carpenter - Instrument Person (Surveying & Layout)	5/1/2025		\$47.47	\$29.02	\$76.49
Carpenter - Rodman (Surveying & Layout)	5/1/2025		\$23.74	\$20.62	\$44.36
Carpenters	5/1/2026		\$48.55	\$30.39	\$78.94
Carpenters	5/1/2027		\$50.46	\$30.74	\$81.20
Carpenters	5/1/2028		\$52.43	\$31.09	\$83.52
Carpenters	5/1/2029		\$54.46	\$31.44	\$85.90
Carpenters	5/1/2030		\$56.55	\$31.79	\$88.34
Cement Finishers & Plasterers	5/1/2022		\$38.57	\$32.39	\$70.96
Cement Masons	5/1/2024		\$46.70	\$32.46	\$79.16
Cement Masons	5/1/2025		\$48.70	\$32.46	\$81.16
Dockbuilder, Pile Drivers	5/1/2026		\$56.98	\$37.99	\$94.97
Dockbuilder/Pile Driver Diver	5/1/2026		\$66.54	\$41.74	\$108.28
Dockbuilder/pile driver tender	5/1/2026		\$56.98	\$37.99	\$94.97
Drywall Finisher	5/1/2025		\$40.14	\$32.35	\$72.49
Drywall Finisher	5/1/2026		\$41.10	\$32.99	\$74.09
Electricians	5/1/2025		\$58.63	\$47.28	\$105.91
Electricians	5/1/2026		\$62.41	\$48.50	\$110.91
Electricians	5/1/2027		\$66.53	\$50.63	\$117.16
Electricians	5/1/2028		\$70.83	\$52.83	\$123.66
Elevator Constructor	1/1/2025		\$71.85	\$45.77	\$117.62
Elevator Constructor	1/1/2026		\$74.86	\$46.86	\$121.72
Floor Coverer	5/1/2025		\$51.67	\$31.69	\$83.36
Floor Coverer	5/1/2026		\$52.84	\$32.86	\$85.70
Glazier	5/1/2025		\$49.96	\$38.34	\$88.30
Glazier	5/1/2026		\$51.30	\$39.37	\$90.67
Interior Finish	5/1/2023		\$34.60	\$25.80	\$60.40
Iron Workers (Bridge, Structural, Ornamental, Precast)	7/1/2024		\$53.20	\$45.01	\$98.21
Iron Workers (Riggers)	7/1/2025		\$44.77	\$36.27	\$81.04
Iron Workers (Riggers)	7/1/2026		\$48.84	\$36.52	\$85.36
Iron Workers (Rodman/Reinforcing)	7/1/2024		\$47.70	\$34.77	\$82.47
Iron Workers (Rodman/Reinforcing)	7/1/2025		\$47.80	\$36.65	\$84.45
Iron Workers (Rodman/Reinforcing)	7/1/2026		\$52.39	\$36.90	\$89.29
Laborers (Class 01 - See notes)	5/1/2025		\$37.25	\$26.10	\$63.35
Laborers (Class 02 - See notes)	5/1/2025		\$41.00	\$27.70	\$68.70
Laborers (Class 03 - See notes)	5/1/2025		\$37.67	\$26.28	\$63.95
Laborers (Class 04 - See notes)	5/1/2025		\$37.67	\$26.28	\$63.95
Laborers (Class 05 - See notes)	5/1/2025		\$37.25	\$26.10	\$63.35
Landscape Laborer	5/1/2025		\$32.15	\$24.30	\$56.45

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08388 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Marble Finisher	5/1/2025		\$41.17	\$30.75	\$71.92
Marble Finisher	5/1/2026		\$42.07	\$31.85	\$73.92
Marble Mason	5/1/2023		\$47.20	\$31.95	\$79.15
Marble Setter	5/1/2026		\$51.50	\$33.80	\$85.30
Mason Tender, Cement	5/1/2023		\$35.02	\$25.98	\$61.00
Millwright	5/1/2025		\$57.39	\$35.81	\$93.20
Millwright	5/1/2026		\$60.20	\$35.81	\$96.01
Operators (Building, Class 01 - See Notes)	5/1/2025		\$54.52	\$34.49	\$89.01
Operators (Building, Class 01 - See Notes)	5/1/2026		\$55.67	\$35.34	\$91.01
Operators (Building, Class 01A - See Notes)	5/1/2025		\$57.52	\$35.38	\$92.90
Operators (Building, Class 01A - See Notes)	5/1/2026		\$58.68	\$36.22	\$94.90
Operators (Building, Class 02 - See Notes)	5/1/2025		\$54.27	\$34.42	\$88.69
Operators (Building, Class 02 - See Notes)	5/1/2026		\$55.43	\$35.26	\$90.69
Operators (Building, Class 02A - See Notes)	5/1/2025		\$57.29	\$35.29	\$92.58
Operators (Building, Class 02A - See Notes)	5/1/2026		\$58.44	\$36.14	\$94.58
Operators (Building, Class 03 - See Notes)	5/1/2025		\$50.18	\$33.22	\$83.40
Operators (Building, Class 03 - See Notes)	5/1/2026		\$51.34	\$34.06	\$85.40
Operators (Building, Class 04 - See Notes)	5/1/2025		\$49.88	\$33.13	\$83.01
Operators (Building, Class 04 - See Notes)	5/1/2026		\$51.04	\$33.97	\$85.01
Operators (Building, Class 05 - See Notes)	5/1/2025		\$48.16	\$32.62	\$80.78
Operators (Building, Class 05 - See Notes)	5/1/2026		\$49.32	\$33.46	\$82.78
Operators (Building, Class 06 - See Notes)	5/1/2025		\$47.17	\$32.33	\$79.50
Operators (Building, Class 06 - See Notes)	5/1/2026		\$48.34	\$33.16	\$81.50
Operators (Building, Class 07A- See Notes)	5/1/2025		\$66.26	\$39.55	\$105.81
Operators (Building, Class 07A- See Notes)	5/1/2026		\$67.73	\$40.48	\$108.21
Operators (Building, Class 07B- See Notes)	5/1/2025		\$65.97	\$39.46	\$105.43
Operators (Building, Class 07B- See Notes)	5/1/2026		\$67.44	\$40.39	\$107.83
Painters Class 1 (see notes)	5/1/2025		\$44.38	\$34.55	\$78.93
Painters Class 1 (see notes)	5/1/2026		\$45.71	\$35.22	\$80.93
Painters - Line Stripping	12/1/2024		\$44.12	\$27.91	\$72.03
Painters - Line Stripping	12/1/2025		\$45.12	\$29.41	\$74.53
Painters Class 4 (see notes)	5/1/2025		\$46.47	\$34.55	\$81.02
Painters Class 4 (see notes)	5/1/2026		\$48.45	\$35.22	\$83.67
Plasterers	5/1/2024		\$39.88	\$33.08	\$72.96
plumber	5/1/2025		\$70.53	\$39.46	\$109.99
plumber	5/1/2026		\$73.73	\$40.36	\$114.09
Pointers, Caulkers, Cleaners	5/1/2025		\$51.35	\$31.80	\$83.15
Pointers, Caulkers, Cleaners	5/1/2026		\$53.35	\$32.30	\$85.65
Roofers (Composition)	5/1/2025		\$46.03	\$34.77	\$80.80
Roofers (Composition)	5/1/2026		\$47.53	\$35.22	\$82.75
Roofers (Shingle)	5/1/2024		\$34.35	\$22.20	\$56.55
Roofers (Slate & Tile)	5/1/2024		\$37.35	\$22.20	\$59.55
Sheet Metal Workers	5/1/2025		\$62.62	\$52.17	\$114.79
Sheet Metal Workers	5/1/2026		\$65.06	\$54.48	\$119.54

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08388 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Sign Makers and Hangars	7/15/2025		\$33.48	\$26.41	\$59.89
Sign Makers and Hangars	7/15/2026		\$36.38	\$25.01	\$61.39
Sprinklerfitters	1/1/2023		\$62.23	\$31.99	\$94.22
Sprinklerfitters	5/1/2025		\$70.37	\$34.85	\$105.22
Steamfitters	5/1/2024		\$70.32	\$43.09	\$113.41
Steamfitters	5/1/2025		\$72.52	\$44.89	\$117.41
Stone Masons	5/1/2025		\$50.00	\$32.80	\$82.80
Stone Masons	5/1/2026		\$51.50	\$33.80	\$85.30
Terrazzo Finisher	5/1/2025		\$45.61	\$29.41	\$75.02
Terrazzo Finisher	5/1/2026		\$47.78	\$29.61	\$77.39
Terrazzo Grinder	5/1/2025		\$45.88	\$29.41	\$75.29
Terrazzo Grinder	5/1/2026		\$47.78	\$29.61	\$77.39
Terrazzo Mechanics	5/1/2025		\$52.21	\$31.26	\$83.47
Terrazzo Mechanics	5/1/2026		\$53.36	\$32.61	\$85.97
Tile Finisher	5/1/2025		\$41.17	\$30.75	\$71.92
Tile Finisher	5/1/2026		\$42.07	\$31.85	\$73.92
Tile Setter	5/1/2025		\$52.21	\$31.26	\$83.47
Tile Setter	5/1/2026		\$53.36	\$32.61	\$85.97
Truckdriver class 1(see notes)	5/1/2024		\$36.79	\$22.54	\$59.33
Truckdriver class 1(see notes)	5/1/2026		\$38.57	\$23.87	\$62.44
Truckdriver class 2 (see notes)	5/1/2024		\$36.89	\$22.54	\$59.43
Truckdriver class 2 (see notes)	5/1/2026		\$38.67	\$23.87	\$62.54
Truckdriver class 3 (see notes)	5/1/2026		\$38.92	\$23.87	\$62.79
Window Film / Tint Installer	6/1/2025		\$27.42	\$15.13	\$42.55

BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project: 26-08388 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Bricklayer	5/1/2025		\$50.00	\$32.57	\$82.57
Bricklayer	5/1/2026		\$51.15	\$34.92	\$86.07
Carpenter - Chief of Party (Surveying & Layout)	5/1/2025		\$65.96	\$30.09	\$96.05
Carpenter - Chief of Party (Surveying & Layout)	5/1/2026		\$67.52	\$30.44	\$97.96
Carpenter - Instrument Person (Surveying & Layout)	5/1/2025		\$58.39	\$29.06	\$87.45
Carpenter - Instrument Person (Surveying & Layout)	5/1/2026		\$60.09	\$29.06	\$89.15
Carpenter - Rodman (Surveying & Layout)	5/1/2025		\$45.88	\$23.19	\$69.07
Carpenter - Rodman (Surveying & Layout)	5/1/2026		\$46.97	\$23.54	\$70.51
Carpenter	5/1/2025		\$57.36	\$30.09	\$87.45
Carpenter	5/1/2026		\$58.71	\$30.44	\$89.15
Cement Masons	5/1/2023		\$43.20	\$32.91	\$76.11
Cement Masons	5/1/2025		\$46.55	\$32.66	\$79.21
Dockbuilder, Pile Drivers	5/1/2026		\$56.98	\$37.99	\$94.97
Dockbuilder/Pile Driver Diver	5/1/2026		\$61.88	\$45.47	\$107.35
Dockbuilder/pile driver tender	5/1/2026		\$56.98	\$37.99	\$94.97
Electric Lineman	6/3/2024		\$62.07	\$33.96	\$96.03
Electric Lineman	6/2/2025		\$65.10	\$34.45	\$99.55
Iron Workers (Bridge, Structural, Ornamental, Precast)	7/1/2024		\$53.20	\$45.01	\$98.21
Iron Workers (Riggers)	7/1/2023		\$42.53	\$34.14	\$76.67
Iron Workers (Rodman/Reinforcing)	7/1/2023		\$45.70	\$34.77	\$80.47
Laborers (Class 01 - See notes)	5/1/2025		\$40.20	\$27.80	\$68.00
Laborers (Class 01 - See notes)	5/1/2026		\$41.65	\$27.90	\$69.55
Laborers (Class 02 - See notes)	5/1/2025		\$40.40	\$27.80	\$68.20
Laborers (Class 02 - See notes)	5/1/2026		\$41.85	\$27.90	\$69.75
Laborers (Class 03 - See notes)	5/1/2025		\$40.40	\$27.80	\$68.20
Laborers (Class 03 - See notes)	5/1/2026		\$41.85	\$27.90	\$69.75
Laborers (Class 04 - See notes)	5/1/2025		\$35.00	\$27.80	\$62.80
Laborers (Class 04 - See notes)	5/1/2026		\$36.45	\$27.90	\$64.35
Laborers (Class 05 - See notes)	5/1/2025		\$41.05	\$27.80	\$68.85
Laborers (Class 05 - See notes)	5/1/2026		\$42.50	\$27.90	\$70.40
Laborers (Class 06 - See notes)	5/1/2025		\$41.10	\$27.80	\$68.90
Laborers (Class 06 - See notes)	5/1/2026		\$42.55	\$27.90	\$70.45
Laborers (Class 07 - See notes)	5/1/2025		\$40.95	\$27.80	\$68.75
Laborers (Class 07 - See notes)	5/1/2026		\$42.40	\$27.90	\$70.30
Laborers (Class 08 - See notes)	5/1/2025		\$40.70	\$27.80	\$68.50
Laborers (Class 08 - See notes)	5/1/2026		\$42.15	\$27.90	\$70.05
Laborers (Class 09 - See notes)	5/1/2025		\$40.55	\$27.80	\$68.35
Laborers (Class 09 - See notes)	5/1/2026		\$42.00	\$27.90	\$69.90
Laborers (Class 10- See notes)	5/1/2025		\$40.70	\$27.80	\$68.50
Laborers (Class 10- See notes)	5/1/2026		\$42.15	\$27.90	\$70.05
Laborers (Class 11 -See Notes)	5/1/2025		\$40.60	\$27.80	\$68.40
Laborers (Class 11 -See Notes)	5/1/2026		\$42.05	\$27.90	\$69.95
Laborers (Class 12 -See Notes)	5/1/2025		\$42.30	\$27.80	\$70.10
Laborers (Class 12 -See Notes)	5/1/2026		\$42.85	\$27.90	\$70.75

BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project: 26-08388 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Laborers (Class 13 -See Notes)	5/1/2025		\$44.33	\$27.80	\$72.13
Laborers (Class 13 -See Notes)	5/1/2026		\$45.78	\$27.90	\$73.68
Laborers (Class 14 -See Notes)	5/1/2025		\$40.90	\$27.80	\$68.70
Laborers (Class 14 -See Notes)	5/1/2026		\$41.90	\$27.90	\$69.80
Laborers Utility (PGW ONLY) (Flagperson)	5/1/2025		\$34.07	\$19.73	\$53.80
Laborers Utility (PGW ONLY) (Flagperson)	5/1/2026		\$35.52	\$19.83	\$55.35
Laborers Utility (PGW ONLY)	5/1/2024		\$39.70	\$19.63	\$59.33
Laborers Utility (PGW ONLY)	5/1/2025		\$41.10	\$19.73	\$60.83
Laborers Utility (PGW ONLY)	5/1/2026		\$42.55	\$19.83	\$62.38
Landscape Laborer	5/1/2024		\$30.28	\$24.05	\$54.33
Landscape Laborer	5/1/2025		\$31.73	\$24.15	\$55.88
Millwright	5/1/2025		\$57.39	\$35.81	\$93.20
Millwright	5/1/2026		\$60.20	\$35.81	\$96.01
Operators Class 01 - See Notes (Building, Heavy, Highway)	5/1/2025		\$54.52	\$34.49	\$89.01
Operators Class 01 - See Notes (Building, Heavy, Highway)	5/1/2026		\$55.67	\$35.34	\$91.01
Operators Class 01a - See Notes (Building, Heavy, Highway)	5/1/2025		\$57.52	\$35.38	\$92.90
Operators Class 01a - See Notes (Building, Heavy, Highway)	5/1/2026		\$58.68	\$36.22	\$94.90
Operators Class 02 - See Notes (Building, Heavy, Highway)	5/1/2025		\$54.27	\$34.42	\$88.69
Operators Class 02 - See Notes (Building, Heavy, Highway)	5/1/2026		\$55.43	\$35.26	\$90.69
Operators Class 02a - See Notes (Building, Heavy, Highway)	5/1/2025		\$57.29	\$35.29	\$92.58
Operators Class 02a - See Notes (Building, Heavy, Highway)	5/1/2026		\$58.44	\$36.14	\$94.58
Operators Class 03 - See Notes (Building, Heavy, Highway)	5/1/2025		\$50.18	\$33.22	\$83.40
Operators Class 03 - See Notes (Building, Heavy, Highway)	5/1/2026		\$51.34	\$34.06	\$85.40
Operators Class 04 - See Notes (Building, Heavy, Highway)	5/1/2025		\$49.88	\$33.13	\$83.01
Operators Class 04 - See Notes (Building, Heavy, Highway)	5/1/2026		\$51.04	\$33.97	\$85.01
Operators Class 05 - See Notes (Building, Heavy, Highway)	5/1/2025		\$48.16	\$32.62	\$80.78
Operators Class 05 - See Notes (Building, Heavy, Highway)	5/1/2026		\$49.32	\$33.46	\$82.78
Operators Class 06 - See Notes (Building, Heavy, Highway)	5/1/2025		\$47.17	\$32.33	\$79.50
Operators Class 06 - See Notes (Building, Heavy, Highway)	5/1/2026		\$48.34	\$33.16	\$81.50
Operators Class 07 (A) - See Notes (Building, Heavy, Highway)	5/1/2025		\$66.26	\$39.55	\$105.81
Operators Class 07 (A) - See Notes (Building, Heavy, Highway)	5/1/2026		\$67.73	\$40.48	\$108.21
Operators Class 07 (B) - See Notes (Building, Heavy, Highway)	5/1/2025		\$65.97	\$39.46	\$105.43

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08388 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Operators Class 07 (B) - See Notes (Building, Heavy, Highway)	5/1/2026		\$67.44	\$40.39	\$107.83
Painters - Line Stripping	12/1/2024		\$44.12	\$27.91	\$72.03
Painters - Line Stripping	12/1/2025		\$45.12	\$29.41	\$74.53
Painters Class 2 (see notes)	2/1/2025		\$50.85	\$33.91	\$84.76
Painters Class 2 (see notes)	2/1/2026		\$51.61	\$35.00	\$86.61
Painters Class 3 (see notes)	2/1/2025		\$61.81	\$33.95	\$95.76
Painters Class 3 (see notes)	2/1/2026		\$62.57	\$35.04	\$97.61
Pointers, Caulkers, Cleaners	5/1/2025		\$51.35	\$31.80	\$83.15
Steamfitters (Heavy and Highway - Gas Distribution)	5/1/2025		\$68.89	\$44.73	\$113.62
Steamfitters	5/1/2018		\$56.37	\$34.39	\$90.76
Truckdriver class 1(see notes)	5/1/2024		\$36.64	\$22.54	\$59.18
Truckdriver class 1(see notes)	5/1/2026		\$38.42	\$23.87	\$62.29
Truckdriver class 2 (see notes)	5/1/2024		\$36.74	\$22.54	\$59.28
Truckdriver class 2 (see notes)	5/1/2026		\$38.52	\$23.87	\$62.39
Truckdriver class 3 (see notes)	5/1/2026		\$38.77	\$23.87	\$62.64

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project Name:	HVAC Renovations and Upgrades at West Valley Administration Building
General Description:	Replacement/updating of building mechanical controllers
Project Locality	940 West Valley Road, Wayne, P
Awarding Agency:	Tredyffrin Easttown School District
Contract Award Date:	11/23/2026
Serial Number:	26-08389
Project Classification:	Building
Determination Date:	9/17/2026
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: 26-08389 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Asbestos & Insulation Workers	5/1/2025		\$60.84	\$48.71	\$109.55
Asbestos & Insulation Workers	5/1/2026		\$64.51	\$50.26	\$114.77
Boilermakers	3/1/2018		\$45.89	\$33.73	\$79.62
Bricklayer	5/1/2025		\$50.00	\$32.57	\$82.57
Bricklayer	5/1/2026		\$51.15	\$34.92	\$86.07
Carpenter - Chief of Party (Surveying & Layout)	5/1/2025		\$54.59	\$29.02	\$83.61
Carpenter - Instrument Person (Surveying & Layout)	5/1/2025		\$47.47	\$29.02	\$76.49
Carpenter - Rodman (Surveying & Layout)	5/1/2025		\$23.74	\$20.62	\$44.36
Carpenters	5/1/2026		\$48.55	\$30.39	\$78.94
Carpenters	5/1/2027		\$50.46	\$30.74	\$81.20
Carpenters	5/1/2028		\$52.43	\$31.09	\$83.52
Carpenters	5/1/2029		\$54.46	\$31.44	\$85.90
Carpenters	5/1/2030		\$56.55	\$31.79	\$88.34
Cement Finishers & Plasterers	5/1/2022		\$38.57	\$32.39	\$70.96
Cement Masons	5/1/2024		\$46.70	\$32.46	\$79.16
Cement Masons	5/1/2025		\$48.70	\$32.46	\$81.16
Dockbuilder, Pile Drivers	5/1/2026		\$56.98	\$37.99	\$94.97
Dockbuilder/Pile Driver Diver	5/1/2026		\$66.54	\$41.74	\$108.28
Dockbuilder/pile driver tender	5/1/2026		\$56.98	\$37.99	\$94.97
Drywall Finisher	5/1/2025		\$40.14	\$32.35	\$72.49
Drywall Finisher	5/1/2026		\$41.10	\$32.99	\$74.09
Electricians	5/1/2025		\$58.63	\$47.28	\$105.91
Electricians	5/1/2026		\$62.41	\$48.50	\$110.91
Electricians	5/1/2027		\$66.53	\$50.63	\$117.16
Electricians	5/1/2028		\$70.83	\$52.83	\$123.66
Elevator Constructor	1/1/2025		\$71.85	\$45.77	\$117.62
Elevator Constructor	1/1/2026		\$74.86	\$46.86	\$121.72
Floor Coverer	5/1/2025		\$51.67	\$31.69	\$83.36
Floor Coverer	5/1/2026		\$52.84	\$32.86	\$85.70
Glazier	5/1/2025		\$49.96	\$38.34	\$88.30
Glazier	5/1/2026		\$51.30	\$39.37	\$90.67
Interior Finish	5/1/2023		\$34.60	\$25.80	\$60.40
Iron Workers (Bridge, Structural, Ornamental, Precast)	7/1/2024		\$53.20	\$45.01	\$98.21
Iron Workers (Riggers)	7/1/2025		\$44.77	\$36.27	\$81.04
Iron Workers (Riggers)	7/1/2026		\$48.84	\$36.52	\$85.36
Iron Workers (Rodman/Reinforcing)	7/1/2024		\$47.70	\$34.77	\$82.47
Iron Workers (Rodman/Reinforcing)	7/1/2025		\$47.80	\$36.65	\$84.45
Iron Workers (Rodman/Reinforcing)	7/1/2026		\$52.39	\$36.90	\$89.29
Laborers (Class 01 - See notes)	5/1/2025		\$37.25	\$26.10	\$63.35
Laborers (Class 02 - See notes)	5/1/2025		\$41.00	\$27.70	\$68.70
Laborers (Class 03 - See notes)	5/1/2025		\$37.67	\$26.28	\$63.95
Laborers (Class 04 - See notes)	5/1/2025		\$37.67	\$26.28	\$63.95
Laborers (Class 05 - See notes)	5/1/2025		\$37.25	\$26.10	\$63.35
Landscape Laborer	5/1/2025		\$32.15	\$24.30	\$56.45

BUREAU OF LABOR LAW COMPLIANCE PREVAILING WAGES PROJECT RATES

Project: 26-08389 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Marble Finisher	5/1/2025		\$41.17	\$30.75	\$71.92
Marble Finisher	5/1/2026		\$42.07	\$31.85	\$73.92
Marble Mason	5/1/2023		\$47.20	\$31.95	\$79.15
Marble Setter	5/1/2026		\$51.50	\$33.80	\$85.30
Mason Tender, Cement	5/1/2023		\$35.02	\$25.98	\$61.00
Millwright	5/1/2025		\$57.39	\$35.81	\$93.20
Millwright	5/1/2026		\$60.20	\$35.81	\$96.01
Operators (Building, Class 01 - See Notes)	5/1/2025		\$54.52	\$34.49	\$89.01
Operators (Building, Class 01 - See Notes)	5/1/2026		\$55.67	\$35.34	\$91.01
Operators (Building, Class 01A - See Notes)	5/1/2025		\$57.52	\$35.38	\$92.90
Operators (Building, Class 01A - See Notes)	5/1/2026		\$58.68	\$36.22	\$94.90
Operators (Building, Class 02 - See Notes)	5/1/2025		\$54.27	\$34.42	\$88.69
Operators (Building, Class 02 - See Notes)	5/1/2026		\$55.43	\$35.26	\$90.69
Operators (Building, Class 02A - See Notes)	5/1/2025		\$57.29	\$35.29	\$92.58
Operators (Building, Class 02A - See Notes)	5/1/2026		\$58.44	\$36.14	\$94.58
Operators (Building, Class 03 - See Notes)	5/1/2025		\$50.18	\$33.22	\$83.40
Operators (Building, Class 03 - See Notes)	5/1/2026		\$51.34	\$34.06	\$85.40
Operators (Building, Class 04 - See Notes)	5/1/2025		\$49.88	\$33.13	\$83.01
Operators (Building, Class 04 - See Notes)	5/1/2026		\$51.04	\$33.97	\$85.01
Operators (Building, Class 05 - See Notes)	5/1/2025		\$48.16	\$32.62	\$80.78
Operators (Building, Class 05 - See Notes)	5/1/2026		\$49.32	\$33.46	\$82.78
Operators (Building, Class 06 - See Notes)	5/1/2025		\$47.17	\$32.33	\$79.50
Operators (Building, Class 06 - See Notes)	5/1/2026		\$48.34	\$33.16	\$81.50
Operators (Building, Class 07A- See Notes)	5/1/2025		\$66.26	\$39.55	\$105.81
Operators (Building, Class 07A- See Notes)	5/1/2026		\$67.73	\$40.48	\$108.21
Operators (Building, Class 07B- See Notes)	5/1/2025		\$65.97	\$39.46	\$105.43
Operators (Building, Class 07B- See Notes)	5/1/2026		\$67.44	\$40.39	\$107.83
Painters Class 1 (see notes)	5/1/2025		\$44.38	\$34.55	\$78.93
Painters Class 1 (see notes)	5/1/2026		\$45.71	\$35.22	\$80.93
Painters - Line Stripping	12/1/2024		\$44.12	\$27.91	\$72.03
Painters - Line Stripping	12/1/2025		\$45.12	\$29.41	\$74.53
Painters Class 4 (see notes)	5/1/2025		\$46.47	\$34.55	\$81.02
Painters Class 4 (see notes)	5/1/2026		\$48.45	\$35.22	\$83.67
Plasterers	5/1/2024		\$39.88	\$33.08	\$72.96
plumber	5/1/2025		\$70.53	\$39.46	\$109.99
plumber	5/1/2026		\$73.73	\$40.36	\$114.09
Pointers, Caulkers, Cleaners	5/1/2025		\$51.35	\$31.80	\$83.15
Pointers, Caulkers, Cleaners	5/1/2026		\$53.35	\$32.30	\$85.65
Roofers (Composition)	5/1/2025		\$46.03	\$34.77	\$80.80
Roofers (Composition)	5/1/2026		\$47.53	\$35.22	\$82.75
Roofers (Shingle)	5/1/2024		\$34.35	\$22.20	\$56.55
Roofers (Slate & Tile)	5/1/2024		\$37.35	\$22.20	\$59.55
Sheet Metal Workers	5/1/2025		\$62.62	\$52.17	\$114.79
Sheet Metal Workers	5/1/2026		\$65.06	\$54.48	\$119.54

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08389 - Building	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Sign Makers and Hangars	7/15/2025		\$33.48	\$26.41	\$59.89
Sign Makers and Hangars	7/15/2026		\$36.38	\$25.01	\$61.39
Sprinklerfitters	1/1/2023		\$62.23	\$31.99	\$94.22
Sprinklerfitters	5/1/2025		\$70.37	\$34.85	\$105.22
Steamfitters	5/1/2024		\$70.32	\$43.09	\$113.41
Steamfitters	5/1/2025		\$72.52	\$44.89	\$117.41
Stone Masons	5/1/2025		\$50.00	\$32.80	\$82.80
Stone Masons	5/1/2026		\$51.50	\$33.80	\$85.30
Terrazzo Finisher	5/1/2025		\$45.61	\$29.41	\$75.02
Terrazzo Finisher	5/1/2026		\$47.78	\$29.61	\$77.39
Terrazzo Grinder	5/1/2025		\$45.88	\$29.41	\$75.29
Terrazzo Grinder	5/1/2026		\$47.78	\$29.61	\$77.39
Terrazzo Mechanics	5/1/2025		\$52.21	\$31.26	\$83.47
Terrazzo Mechanics	5/1/2026		\$53.36	\$32.61	\$85.97
Tile Finisher	5/1/2025		\$41.17	\$30.75	\$71.92
Tile Finisher	5/1/2026		\$42.07	\$31.85	\$73.92
Tile Setter	5/1/2025		\$52.21	\$31.26	\$83.47
Tile Setter	5/1/2026		\$53.36	\$32.61	\$85.97
Truckdriver class 1(see notes)	5/1/2024		\$36.79	\$22.54	\$59.33
Truckdriver class 1(see notes)	5/1/2026		\$38.57	\$23.87	\$62.44
Truckdriver class 2 (see notes)	5/1/2024		\$36.89	\$22.54	\$59.43
Truckdriver class 2 (see notes)	5/1/2026		\$38.67	\$23.87	\$62.54
Truckdriver class 3 (see notes)	5/1/2026		\$38.92	\$23.87	\$62.79
Window Film / Tint Installer	6/1/2025		\$27.42	\$15.13	\$42.55

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08389 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Bricklayer	5/1/2025		\$50.00	\$32.57	\$82.57
Bricklayer	5/1/2026		\$51.15	\$34.92	\$86.07
Carpenter - Chief of Party (Surveying & Layout)	5/1/2025		\$65.96	\$30.09	\$96.05
Carpenter - Chief of Party (Surveying & Layout)	5/1/2026		\$67.52	\$30.44	\$97.96
Carpenter - Instrument Person (Surveying & Layout)	5/1/2025		\$58.39	\$29.06	\$87.45
Carpenter - Instrument Person (Surveying & Layout)	5/1/2026		\$60.09	\$29.06	\$89.15
Carpenter - Rodman (Surveying & Layout)	5/1/2025		\$45.88	\$23.19	\$69.07
Carpenter - Rodman (Surveying & Layout)	5/1/2026		\$46.97	\$23.54	\$70.51
Carpenter	5/1/2025		\$57.36	\$30.09	\$87.45
Carpenter	5/1/2026		\$58.71	\$30.44	\$89.15
Cement Masons	5/1/2023		\$43.20	\$32.91	\$76.11
Cement Masons	5/1/2025		\$46.55	\$32.66	\$79.21
Dockbuilder, Pile Drivers	5/1/2026		\$56.98	\$37.99	\$94.97
Dockbuilder/Pile Driver Diver	5/1/2026		\$61.88	\$45.47	\$107.35
Dockbuilder/pile driver tender	5/1/2026		\$56.98	\$37.99	\$94.97
Electric Lineman	6/3/2024		\$62.07	\$33.96	\$96.03
Electric Lineman	6/2/2025		\$65.10	\$34.45	\$99.55
Iron Workers (Bridge, Structural, Ornamental, Precast)	7/1/2024		\$53.20	\$45.01	\$98.21
Iron Workers (Riggers)	7/1/2023		\$42.53	\$34.14	\$76.67
Iron Workers (Rodman/Reinforcing)	7/1/2023		\$45.70	\$34.77	\$80.47
Laborers (Class 01 - See notes)	5/1/2025		\$40.20	\$27.80	\$68.00
Laborers (Class 01 - See notes)	5/1/2026		\$41.65	\$27.90	\$69.55
Laborers (Class 02 - See notes)	5/1/2025		\$40.40	\$27.80	\$68.20
Laborers (Class 02 - See notes)	5/1/2026		\$41.85	\$27.90	\$69.75
Laborers (Class 03 - See notes)	5/1/2025		\$40.40	\$27.80	\$68.20
Laborers (Class 03 - See notes)	5/1/2026		\$41.85	\$27.90	\$69.75
Laborers (Class 04 - See notes)	5/1/2025		\$35.00	\$27.80	\$62.80
Laborers (Class 04 - See notes)	5/1/2026		\$36.45	\$27.90	\$64.35
Laborers (Class 05 - See notes)	5/1/2025		\$41.05	\$27.80	\$68.85
Laborers (Class 05 - See notes)	5/1/2026		\$42.50	\$27.90	\$70.40
Laborers (Class 06 - See notes)	5/1/2025		\$41.10	\$27.80	\$68.90
Laborers (Class 06 - See notes)	5/1/2026		\$42.55	\$27.90	\$70.45
Laborers (Class 07 - See notes)	5/1/2025		\$40.95	\$27.80	\$68.75
Laborers (Class 07 - See notes)	5/1/2026		\$42.40	\$27.90	\$70.30
Laborers (Class 08 - See notes)	5/1/2025		\$40.70	\$27.80	\$68.50
Laborers (Class 08 - See notes)	5/1/2026		\$42.15	\$27.90	\$70.05
Laborers (Class 09 - See notes)	5/1/2025		\$40.55	\$27.80	\$68.35
Laborers (Class 09 - See notes)	5/1/2026		\$42.00	\$27.90	\$69.90
Laborers (Class 10- See notes)	5/1/2025		\$40.70	\$27.80	\$68.50
Laborers (Class 10- See notes)	5/1/2026		\$42.15	\$27.90	\$70.05
Laborers (Class 11 -See Notes)	5/1/2025		\$40.60	\$27.80	\$68.40
Laborers (Class 11 -See Notes)	5/1/2026		\$42.05	\$27.90	\$69.95
Laborers (Class 12 -See Notes)	5/1/2025		\$42.30	\$27.80	\$70.10
Laborers (Class 12 -See Notes)	5/1/2026		\$42.85	\$27.90	\$70.75

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08389 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Laborers (Class 13 -See Notes)	5/1/2025		\$44.33	\$27.80	\$72.13
Laborers (Class 13 -See Notes)	5/1/2026		\$45.78	\$27.90	\$73.68
Laborers (Class 14 -See Notes)	5/1/2025		\$40.90	\$27.80	\$68.70
Laborers (Class 14 -See Notes)	5/1/2026		\$41.90	\$27.90	\$69.80
Laborers Utility (PGW ONLY) (Flagperson)	5/1/2025		\$34.07	\$19.73	\$53.80
Laborers Utility (PGW ONLY) (Flagperson)	5/1/2026		\$35.52	\$19.83	\$55.35
Laborers Utility (PGW ONLY)	5/1/2024		\$39.70	\$19.63	\$59.33
Laborers Utility (PGW ONLY)	5/1/2025		\$41.10	\$19.73	\$60.83
Laborers Utility (PGW ONLY)	5/1/2026		\$42.55	\$19.83	\$62.38
Landscape Laborer	5/1/2024		\$30.28	\$24.05	\$54.33
Landscape Laborer	5/1/2025		\$31.73	\$24.15	\$55.88
Millwright	5/1/2025		\$57.39	\$35.81	\$93.20
Millwright	5/1/2026		\$60.20	\$35.81	\$96.01
Operators Class 01 - See Notes (Building, Heavy, Highway)	5/1/2025		\$54.52	\$34.49	\$89.01
Operators Class 01 - See Notes (Building, Heavy, Highway)	5/1/2026		\$55.67	\$35.34	\$91.01
Operators Class 01a - See Notes (Building, Heavy, Highway)	5/1/2025		\$57.52	\$35.38	\$92.90
Operators Class 01a - See Notes (Building, Heavy, Highway)	5/1/2026		\$58.68	\$36.22	\$94.90
Operators Class 02 - See Notes (Building, Heavy, Highway)	5/1/2025		\$54.27	\$34.42	\$88.69
Operators Class 02 - See Notes (Building, Heavy, Highway)	5/1/2026		\$55.43	\$35.26	\$90.69
Operators Class 02a - See Notes (Building, Heavy, Highway)	5/1/2025		\$57.29	\$35.29	\$92.58
Operators Class 02a - See Notes (Building, Heavy, Highway)	5/1/2026		\$58.44	\$36.14	\$94.58
Operators Class 03 - See Notes (Building, Heavy, Highway)	5/1/2025		\$50.18	\$33.22	\$83.40
Operators Class 03 - See Notes (Building, Heavy, Highway)	5/1/2026		\$51.34	\$34.06	\$85.40
Operators Class 04 - See Notes (Building, Heavy, Highway)	5/1/2025		\$49.88	\$33.13	\$83.01
Operators Class 04 - See Notes (Building, Heavy, Highway)	5/1/2026		\$51.04	\$33.97	\$85.01
Operators Class 05 - See Notes (Building, Heavy, Highway)	5/1/2025		\$48.16	\$32.62	\$80.78
Operators Class 05 - See Notes (Building, Heavy, Highway)	5/1/2026		\$49.32	\$33.46	\$82.78
Operators Class 06 - See Notes (Building, Heavy, Highway)	5/1/2025		\$47.17	\$32.33	\$79.50
Operators Class 06 - See Notes (Building, Heavy, Highway)	5/1/2026		\$48.34	\$33.16	\$81.50
Operators Class 07 (A) - See Notes (Building, Heavy, Highway)	5/1/2025		\$66.26	\$39.55	\$105.81
Operators Class 07 (A) - See Notes (Building, Heavy, Highway)	5/1/2026		\$67.73	\$40.48	\$108.21
Operators Class 07 (B) - See Notes (Building, Heavy, Highway)	5/1/2025		\$65.97	\$39.46	\$105.43

**BUREAU OF LABOR LAW COMPLIANCE
PREVAILING WAGES PROJECT RATES**

Project: 26-08389 - Heavy/Highway	Effective Date	Expiration Date	Hourly Rate	Fringe Benefits	Total
Operators Class 07 (B) - See Notes (Building, Heavy, Highway)	5/1/2026		\$67.44	\$40.39	\$107.83
Painters - Line Stripping	12/1/2024		\$44.12	\$27.91	\$72.03
Painters - Line Stripping	12/1/2025		\$45.12	\$29.41	\$74.53
Painters Class 2 (see notes)	2/1/2025		\$50.85	\$33.91	\$84.76
Painters Class 2 (see notes)	2/1/2026		\$51.61	\$35.00	\$86.61
Painters Class 3 (see notes)	2/1/2025		\$61.81	\$33.95	\$95.76
Painters Class 3 (see notes)	2/1/2026		\$62.57	\$35.04	\$97.61
Pointers, Caulkers, Cleaners	5/1/2025		\$51.35	\$31.80	\$83.15
Steamfitters (Heavy and Highway - Gas Distribution)	5/1/2025		\$68.89	\$44.73	\$113.62
Steamfitters	5/1/2018		\$56.37	\$34.39	\$90.76
Truckdriver class 1(see notes)	5/1/2024		\$36.64	\$22.54	\$59.18
Truckdriver class 1(see notes)	5/1/2026		\$38.42	\$23.87	\$62.29
Truckdriver class 2 (see notes)	5/1/2024		\$36.74	\$22.54	\$59.28
Truckdriver class 2 (see notes)	5/1/2026		\$38.52	\$23.87	\$62.39
Truckdriver class 3 (see notes)	5/1/2026		\$38.77	\$23.87	\$62.64



AIA Document A201

General Conditions of the Contract for Construction

*THIS DOCUMENT HAS IMPORTANT LEGAL CONSEQUENCES; CONSULTATION
WITH AN ATTORNEY IS ENCOURAGED WITH RESPECT TO ITS MODIFICATION*

1987 EDITION TABLE OF ARTICLES

- | | |
|--|--|
| 1. GENERAL PROVISIONS | 8. TIME |
| 2. OWNER | 9. PAYMENTS AND COMPLETION |
| 3. CONTRACTOR | 10. PROTECTION OF PERSONS AND PROPERTY |
| 4. ADMINISTRATION OF THE CONTRACT | 11. INSURANCE AND BONDS |
| 5. SUBCONTRACTORS | 12. UNCOVERING AND CORRECTION OF WORK |
| 6. CONSTRUCTION BY OWNER OR BY
SEPARATE CONTRACTORS | 13. MISCELLANEOUS PROVISIONS |
| 7. CHANGES IN THE WORK | 14. TERMINATION OR SUSPENSION OF THE
CONTRACT |

This document has been approved and endorsed by the Associated General Contractors of America.

Copyright 1911, 1915, 1918, 1925, 1937, 1951, 1958, 1961, 1963, 1966, 1967, 1970, 1976, ©1987 by The American Institute of Architects, 1735 New York Avenue, N.W., Washington, D.C., 20006. Reproduction of the material herein or substantial quotation of its provisions without written permission of the AIA violates the copyright laws of the United States and will be subject to legal prosecutions.

INDEX

- Acceptance of Nonconforming Work** 9.6.6, 9.9.3, 12.3
Acceptance of Work 9.6.6, 9.8.2, 9.9.3, 9.10.1, 9.10.3
Access to Work 3.16, 6.2.1, 12.1
Accident Prevention 4.2.3, 10
Acts and Omissions 3.2.1, 3.2.2, 3.3.2, 3.12.8, 3.18, 4.2.3, 4.3.2, 4.3.9, 8.3.1, 10.1.4, 10.2.5, 13.4.2, 13.7, 14.1
Addenda 1.1.1, 3.11
Additional Cost, Claims for 4.3.6, 4.3.7, 4.3.9, 6.1.1, 10.3
Additional Inspections and Testing 4.2.6, 9.8.2, 12.2.1, 13.5
Additional Time, Claims for 4.3.6, 4.3.8, 4.3.9, 8.3.2
ADMINISTRATION OF THE CONTRACT 3.3.3, 4, 9.4, 9.5
Advertisement or Invitation to Bid 1.1.1
Aesthetic Effect 4.2.13, 4.5.1
Allowances 3.8
All-risk Insurance 11.3.1.1
Applications for Payment 4.2.5, 7.3.7, 9.2, 9.3, 9.4, 9.5.1, 9.6.3, 9.8.3, 9.10.1, 9.10.3, 9.10.4, 11.1.3, 14.2.4
Approvals 2.4, 3.3.3, 3.5, 3.10.2, 3.12.4 through 3.12.8, 3.18.3, 4.2.7, 9.3.2, 11.3.1.4, 13.4.2, 13.5
Arbitration 4.1.4, 4.3.2, 4.3.4, 4.4.4, 4.5, 8.3.1, 10.1.2, 11.3.9, 11.3.10
Architect 4.1
Architect, Definition of 4.1.1
Architect, Extent of Authority 2.4, 3.12.6, 4.2, 4.3.2, 4.3.6, 4.4, 5.2, 6.3, 7.1.2, 7.2.1, 7.3.6, 7.4, 9.2, 9.3.1, 9.4, 9.5, 9.6.3, 9.8.2, 9.8.3, 9.10.1, 9.10.3, 12.1, 12.2.1, 13.5.1, 13.5.2, 14.2.2, 14.2.4
Architect, Limitations of Authority and Responsibility 3.3.3, 3.12.8, 3.12.11, 4.1.2, 4.2.1, 4.2.2, 4.2.3, 4.2.6, 4.2.7, 4.2.10, 4.2.12, 4.2.13, 4.3.2, 5.2.1, 7.4, 9.4.2, 9.6.4, 9.6.6
Architect's Additional Services and Expenses 2.4, 9.8.2, 11.3.1.1, 12.2.1, 12.2.4, 13.5.2, 13.5.3, 14.2.4
Architect's Administration of the Contract 4.2, 4.3.6, 4.3.7, 4.4, 9.4, 9.5
Architect's Approvals 2.4, 3.5.1, 3.10.2, 3.12.6, 3.12.8, 3.18.3, 4.2.7
Architect's Authority to Reject Work 3.5.1, 4.2.6, 12.1.2, 12.2.1
Architect's Copyright 1.3
Architect's Decisions 4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 4.3.2, 4.3.6, 4.4.1, 4.4.4, 4.5, 6.3, 7.3.6, 7.3.8, 8.1.3, 8.3.1, 9.2, 9.4, 9.5.1, 9.8.2, 9.9.1, 10.1.2, 13.5.2, 14.2.2, 14.2.4
Architect's Inspections 4.2.2, 4.2.9, 4.3.6, 9.4.2, 9.8.2, 9.9.2, 9.10.1, 13.5
Architect's Instructions 4.2.6, 4.2.7, 4.2.8, 4.3.7, 7.4.1, 12.1, 13.5.2
Architect's Interpretations 4.2.11, 4.2.12, 4.3.7
Architect's On-Site Observations 4.2.2, 4.2.5, 4.3.6, 9.4.2, 9.5.1, 9.10.1, 13.5
Architect's Project Representative 4.2.10
Architect's Relationship with Contractor 1.1.2, 3.2.1, 3.2.2, 3.3.3, 3.5.1, 3.7.3, 3.11, 3.12.8, 3.12.11, 3.16, 3.18, 4.2.3, 4.2.4, 4.2.6, 4.2.12, 5.2, 6.2.2, 7.3.4, 9.8.2, 11.3.7, 12.1, 13.5
Architect's Relationship with Subcontractors 1.1.2, 4.2.3, 4.2.4, 4.2.6, 9.6.3, 9.6.4, 11.3.7
Architect's Representations 9.4.2, 9.5.1, 9.10.1
Architect's Site Visits 4.2.2, 4.2.5, 4.2.9, 4.3.6, 9.4.2, 9.5.1, 9.8.2, 9.9.2, 9.10.1, 13.5
Asbestos 10.1
Attorneys' Fees 3.18.1, 9.10.2, 10.1.4
Award of Separate Contracts 6.1.1
Award of Subcontracts and Other Contracts for Portions of the Work 5.2
Basic Definitions 1.1
Bidding Requirements 1.1.1, 1.1.7, 5.2.1, 11.4.1
Boiler and Machinery Insurance 11.3.2
Bonds, Lien 9.10.2
Bonds, Performance and Payment 7.3.6.4, 9.10.3, 11.3.9, 11.4
Building Permit 3.7.1
Capitalization 1.4
Certificate of Substantial Completion 9.8.2
Certificates for Payment 4.2.5, 4.2.9, 9.3.3, 9.4, 9.5, 9.6.1, 9.6.6, 9.7.1, 9.8.3, 9.10.1, 9.10.3, 13.7, 14.1.1.3, 14.2.4
Certificates of Inspection, Testing or Approval 3.12.11, 13.5.4
Certificates of Insurance 9.3.2, 9.10.2, 11.1.3
Change Orders 1.1.1, 2.4.1, 3.8.2.4, 3.11, 4.2.8, 4.3.3, 5.2.3, 7.1, 7.2, 7.3.2, 8.3.1, 9.3.1.1, 9.10.3, 11.3.1.2, 11.3.4, 11.3.9, 12.1.2
Change Orders, Definition of 7.2.1
Changes 7.1
CHANGES IN THE WORK 3.11, 4.2.8, 7, 8.3.1, 9.3.1.1, 10.1.3
Claim, Definition of 4.3.1
Claims and Disputes 4.3, 4.4, 4.5, 6.2.5, 8.3.2, 9.3.1.2, 9.3.3, 9.10.4, 10.1.4
Claims and Timely Assertion of Claims 4.5.6
Claims for Additional Cost 4.3.6, 4.3.7, 4.3.9, 6.1.1, 10.3
Claims for Additional Time 4.3.6, 4.3.8, 4.3.9, 8.3.2
Claims for Concealed or Unknown Conditions 4.3.6
Claims for Damages 3.18, 4.3.9, 6.1.1, 6.2.5, 8.3.2, 9.5.1.2, 10.1.4
Claims Subject to Arbitration 4.3.2, 4.4.4, 4.5.1
Cleaning Up 3.15, 6.3
Commencement of Statutory Limitation Period 13.7
Commencement of the Work, Conditions Relating to 2.1.2, 2.2.1, 3.2.1, 3.2.2, 3.7.1, 3.10.1, 3.12.6, 4.3.7, 5.2.1, 6.2.2, 8.1.2, 8.2.2, 9.2, 11.1.3, 11.3.6, 11.4.1
Commencement of the Work, Definition of 8.1.2
Communications Facilitating Contract Administration 3.9.1, 4.2.4, 5.2.1
Completion, Conditions Relating to 3.11, 3.15, 4.2.2, 4.2.9, 4.3.2, 9.4.2, 9.8, 9.9.1, 9.10, 11.3.5, 12.2.2, 13.7.1
COMPLETION, PAYMENTS AND 9
Completion, Substantial 4.2.9, 4.3.5.2, 8.1.1, 8.1.3, 8.2.3, 9.8, 9.9.1, 12.2.2, 13.7
Compliance with Laws 1.3, 3.6, 3.7, 3.13, 4.1.1, 10.2.2, 11.1, 11.3, 13.1, 13.5.1, 13.5.2, 13.6, 14.1.1, 14.2.1.3
Concealed or Unknown Conditions 4.3.6
Conditions of the Contract 1.1.1, 1.1.7, 6.1.1
Consent, Written 1.3.1, 3.12.8, 3.14.2, 4.1.2, 4.3.4, 4.5.5, 9.3.2, 9.8.2, 9.9.1, 9.10.2, 9.10.3, 10.1.2, 10.1.3, 11.3.1, 11.3.1.4, 11.3.11, 13.2, 13.4.2
CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS 1.1.4, 6
Construction Change Directive, Definition of 7.3.1
Construction Change Directives 1.1.1, 4.2.8, 7.1, 7.3, 9.3.1.1
Construction Schedules, Contractor's 3.10, 6.1.3
Contingent Assignment of Subcontracts 5.4
Continuing Contract Performance 4.3.4
Contract, Definition of 1.1.2
CONTRACT, TERMINATION OR SUSPENSION OF THE 4.3.7, 5.4.1.1, 14
Contract Administration 3.3.3, 4, 9.4, 9.5
Contract Award and Execution, Conditions Relating to 3.7.1, 3.10, 5.2, 9.2, 11.1.3, 11.3.6, 11.4.1
Contract Documents, The 1.1, 1.2, 7
Contract Documents, Copies Furnished and Use of 1.3, 2.2.5, 5.3
Contract Documents, Definition of 1.1.1
Contract Performance During Arbitration 4.3.4, 4.5.3
Contract Sum 3.8, 4.3.6, 4.3.7, 4.4.4, 5.2.3, 6.1.3, 7.2, 7.3, 9.1, 9.7, 11.3.1, 12.2.4, 12.3, 14.2.4
Contract Sum, Definition of 9.1
Contract Time 4.3.6, 4.3.8, 4.4.4, 7.2.1.3, 7.3, 8.2.1, 8.3.1, 9.7, 12.1.1
Contract Time, Definition of 8.1.1

CONTRACTOR	3
Contractor, Definition of	3.1, 6.1.2
Contractor's Bid	1.1.1
Contractor's Construction Schedules	3.10, 6.1.3
Contractor's Employees	3.3.2, 3.4.2, 3.8.1, 3.9, 3.18, 4.2.3, 4.2.6, 8.1.2, 10.2, 10.3, 11.1.1, 14.2.1.1
Contractor's Liability Insurance	11.1
Contractor's Relationship with Separate Contractors and Owner's Forces	2.2.6, 3.12.5, 3.14.2, 4.2.4, 6, 12.2.5
Contractor's Relationship with Subcontractors	1.2.4, 3.3.2, 3.18.1, 3.18.2, 5.2, 5.3, 5.4, 9.6.2, 11.3.7, 11.3.8, 14.2.1.2
Contractor's Relationship with the Architect	1.1.2, 3.2.1, 3.2.2, 3.3.3, 3.5.1, 3.7.3, 3.11, 3.12.8, 3.16, 3.18, 4.2.3, 4.2.4, 4.2.6, 4.2.12, 5.2, 6.2.2, 7.3.4, 9.8.2, 11.3.7, 12.1, 13.5
Contractor's Representations	1.2.2, 3.5.1, 3.12.7, 6.2.2, 8.2.1, 9.3.3
Contractor's Responsibility for Those Performing the Work	3.3.2, 3.18, 4.2.3, 10
Contractor's Review of Contract Documents	1.2.2, 3.2, 3.7.3
Contractor's Right to Stop the Work	9.7
Contractor's Right to Terminate the Contract	14.1
Contractor's Submittals	3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 7.3.6, 9.2, 9.3.1, 9.8.2, 9.9.1, 9.10.2, 9.10.3, 10.1.2, 11.4.2, 11.4.3
Contractor's Superintendent	3.9, 10.2.6
Contractor's Supervision and Construction Procedures	1.2.4, 3.3, 3.4, 4.2.3, 8.2.2, 8.2.3, 10
Contractual Liability Insurance	11.1.1.7, 11.2.1
Coordination and Correlation	1.2.2, 1.2.4, 3.3.1, 3.10, 3.12.7, 6.1.3, 6.2.1
Copies Furnished of Drawings and Specifications	1.3, 2.2.5, 3.11
Correction of Work	2.3, 2.4, 4.2.1, 9.8.2, 9.9.1, 12.1.2, 12.2, 13.7.1.3
Cost, Definition of	7.3.6, 14.3.5
Costs	2.4, 3.2.1, 3.7.4, 3.8.2, 3.15.2, 4.3.6, 4.3.7, 4.3.8.1, 5.2.3, 6.1.1, 6.2.3, 6.3, 7.3.3.3, 7.3.6, 7.3.7, 9.7, 9.8.2, 9.10.2, 11.3.1.2, 11.3.1.3, 11.3.4, 11.3.9, 12.1, 12.2.1, 12.2.4, 12.2.5, 13.5, 14
Cutting and Patching	3.14, 6.2.6
Damage to Construction of Owner or Separate Contractors	3.14.2, 6.2.4, 9.5.1.5, 10.2.1.2, 10.2.5, 10.3, 11.1, 11.3, 12.2.5
Damage to the Work	3.14.2, 9.9.1, 10.2.1.2, 10.2.5, 10.3, 11.3
Damages, Claims for	3.18, 4.3.9, 6.1.1, 6.2.5, 8.3.2, 9.5.1.2, 10.1.4
Damages for Delay	6.1.1, 8.3.3, 9.5.1.6, 9.7
Date of Commencement of the Work, Definition of	8.1.2
Date of Substantial Completion, Definition of	8.1.3
Day, Definition of	8.1.4
Decisions of the Architect	4.2.6, 4.2.7, 4.2.11, 4.2.12, 4.2.13, 4.3.2, 4.3.6, 4.4.1, 4.4.4, 4.5, 6.3, 7.3.6, 7.3.8, 8.1.3, 8.3.1, 9.2, 9.4, 9.5.1, 9.8.2, 9.9.1, 10.1.2, 13.5.2, 14.2.2, 14.2.4
Decisions to Withhold Certification	9.5, 9.7, 14.1.1.3
Defective or Nonconforming Work, Acceptance, Rejection and Correction of	2.3, 2.4, 3.5.1, 4.2.1, 4.2.6, 4.3.5, 9.5.2, 9.8.2, 9.9.1, 10.2.5, 12, 13.7.1.3
Defective Work, Definition of	3.5.1
Definitions	1.1, 2.1.1, 3.1, 3.5.1, 3.12.1, 3.12.2, 3.12.3, 4.1.1, 4.3.1, 5.1, 6.1.2, 7.2.1, 7.3.1, 7.3.6, 8.1, 9.1, 9.8.1
Delays and Extensions of Time	4.3.1, 4.3.8.1, 4.3.8.2, 6.1.1, 6.2.3, 7.2.1, 7.3.1, 7.3.4, 7.3.5, 7.3.8, 7.3.9, 8.1.1, 8.3, 10.3.1, 14.1.1.4
Disputes	4.1.4, 4.3, 4.4, 4.5, 6.2.5, 6.3, 7.3.8, 9.3.1.2
Documents and Samples at the Site	3.11
Drawings, Definition of	1.1.5
Drawings and Specifications, Use and Ownership of	1.1.1, 1.3, 2.2.5, 3.11, 5.3
Duty to Review Contract Documents and Field Conditions	3.2
Effective Date of Insurance	8.2.2, 11.1.2
Emergencies	4.3.7, 10.3
Employees, Contractor's	3.3.2, 3.4.2, 3.8.1, 3.9, 3.18.1, 3.18.2, 4.2.3, 4.2.6, 8.1.2, 10.2, 10.3, 11.1.1, 14.2.1.1
Equipment, Labor, Materials and	1.1.3, 1.1.6, 3.4, 3.5.1, 3.8.2, 3.12.3, 3.12.7, 3.12.11, 3.13, 3.15.1, 4.2.7, 6.2.1, 7.3.6, 9.3.2, 9.3.3, 11.3, 12.2.4, 14
Execution and Progress of the Work	1.1.3, 1.2.3, 3.2, 3.4.1, 3.5.1, 4.2.2, 4.2.3, 4.3.4, 4.3.8, 6.2.2, 7.1.3, 7.3.9, 8.2, 8.3, 9.5, 9.9.1, 10.2, 14.2, 14.3
Execution, Correlation and Intent of the Contract Documents	1.2, 3.7.1
Extensions of Time	4.3.1, 4.3.8, 7.2.1.3, 8.3, 10.3.1
Failure of Payment by Contractor	9.5.1.3, 14.2.1.2
Failure of Payment by Owner	4.3.7, 9.7, 14.1.3
Faulty Work (See Defective or Nonconforming Work)	
Final Completion and Final Payment	4.2.1, 4.2.9, 4.3.2, 4.3.5, 9.10, 11.1.2, 11.1.3, 11.3.5, 12.3.1, 13.7
Financial Arrangements, Owner's	2.2.1
Fire and Extended Coverage Insurance	11.3
GENERAL PROVISIONS	1
Governing Law	13.1
Guarantees (See Warranty and Warranties)	
Hazardous Materials	10.1, 10.2.4
Identification of Contract Documents	1.2.1
Identification of Subcontractors and Suppliers	5.2.1
Indemnification	3.17, 3.18, 9.10.2, 10.1.4, 11.3.1.2, 11.3.7
Information and Services Required of the Owner	2.1.2, 2.2, 4.3.4, 6.1.3, 6.1.4, 6.2.6, 9.3.2, 9.6.1, 9.6.4, 9.8.3, 9.9.2, 9.10.3, 10.1.4, 11.2, 11.3, 13.5.1, 13.5.2
Injury or Damage to Person or Property	4.3.9
Inspections	3.3.3, 3.3.4, 3.7.1, 4.2.2, 4.2.6, 4.2.9, 4.3.6, 9.4.2, 9.8.2, 9.9.2, 9.10.1, 13.5
Instructions to Bidders	1.1.1
Instructions to the Contractor	3.8.1, 4.2.8, 5.2.1, 7, 12.1, 13.5.2
Insurance	4.3.9, 6.1.1, 7.3.6.4, 9.3.2, 9.8.2, 9.9.1, 9.10.2, 11
Insurance, Boiler and Machinery	11.3.2
Insurance, Contractor's Liability	11.1
Insurance, Effective Date of	8.2.2, 11.1.2
Insurance, Loss of Use	11.3.3
Insurance, Owner's Liability	11.2
Insurance, Property	10.2.5, 11.3
Insurance, Stored Materials	9.3.2, 11.3.1.4
INSURANCE AND BONDS	11
Insurance Companies, Consent to Partial Occupancy	9.9.1, 11.3.11
Insurance Companies, Settlement with	11.3.10
Intent of the Contract Documents	1.2.3, 3.12.4, 4.2.6, 4.2.7, 4.2.12, 4.2.13, 7.4
Interest	13.6
Interpretation	1.2.5, 1.4, 1.5, 4.1.1, 4.3.1, 5.1, 6.1.2, 8.1.4
Interpretations, Written	4.2.11, 4.2.12, 4.3.7
Joinder and Consolidation of Claims Required	4.5.6
Judgment on Final Award	4.5.1, 4.5.4.1, 4.5.7
Labor and Materials, Equipment	1.1.3, 1.1.6, 3.4, 3.5.1, 3.8.2, 3.12.2, 3.12.3, 3.12.7, 3.12.11, 3.13, 3.15.1, 4.2.7, 6.2.1, 7.3.6, 9.3.2, 9.3.3, 12.2.4, 14
Labor Disputes	8.3.1
Laws and Regulations	1.3, 3.6, 3.7, 3.13, 4.1.1, 4.5.5, 4.5.7, 9.9.1, 10.2.2, 11.1, 11.3, 13.1, 13.4, 13.5.1, 13.5.2, 13.6
Liens	2.1.2, 4.3.2, 4.3.5.1, 8.2.2, 9.3.3, 9.10.2
Limitation on Consolidation or Joinder	4.5.5
Limitations, Statutes of	4.5.4.2, 12.2.6, 13.7
Limitations of Authority	3.3.1, 4.1.2, 4.2.1, 4.2.3, 4.2.7, 4.2.10, 5.2.2, 5.2.4, 7.4, 11.3.10

Limitations of Liability	2.3, 3.2.1, 3.5.1, 3.7.3, 3.12.8, 3.12.11, 3.17, 3.18, 4.2.6, 4.2.7, 4.2.12, 6.2.2, 9.4.2, 9.6.4, 9.10.4, 10.1.4, 10.2.5, 11.1.2, 11.2.1, 11.3.7, 13.4.2, 13.5.2
Limitations of Time, General	2.2.1, 2.2.4, 3.2.1, 3.7.3, 3.8.2, 3.10, 3.12.5, 3.15.1, 4.2.1, 4.2.7, 4.2.11, 4.3.2, 4.3.3, 4.3.4, 4.3.6, 4.3.9, 4.5.4.2, 5.2.1, 5.2.3, 6.2.4, 7.3.4, 7.4, 8.2, 9.5, 9.6.2, 9.8, 9.9, 9.10, 11.1.3, 11.3.1, 11.3.2, 11.3.5, 11.3.6, 12.2.1, 12.2.2, 13.5, 13.7
Limitations of Time, Specific	2.1.2, 2.2.1, 2.4, 3.10, 3.11, 3.15.1, 4.2.1, 4.2.11, 4.3, 4.4, 4.5, 5.3, 5.4, 7.3.5, 7.3.9, 8.2, 9.2, 9.3.1, 9.3.3, 9.4.1, 9.6.1, 9.7, 9.8.2, 9.10.2, 11.1.3, 11.3.6, 11.3.10, 11.3.11, 12.2.2, 12.2.4, 12.2.6, 13.7, 14
Loss of Use Insurance	11.3.3
Material Suppliers	1.3.1, 3.12.1, 4.2.4, 4.2.6, 5.2.1, 9.3.1, 9.3.1.2, 9.3.3, 9.4.2, 9.6.5, 9.10.4
Materials, Hazardous	10.1, 10.2.4
Materials, Labor, Equipment and	1.1.3, 1.1.6, 3.4, 3.5.1, 3.8.2, 3.12.2, 3.12.3, 3.12.7, 3.12.11, 3.13, 3.15.1, 4.2.7, 6.2.1, 7.3.6, 9.3.2, 9.3.3, 12.2.4, 14
Means, Methods, Techniques, Sequences and Procedures of Construction	3.3.1, 4.2.3, 4.2.7, 9.4.2
Minor Changes in the Work	1.1.1, 4.2.8, 4.3.7, 7.1, 7.4
MISCELLANEOUS PROVISIONS	13
Modifications, Definition of	1.1.1
Modifications to the Contract	1.1.1, 1.1.2, 3.7.3, 3.11, 4.1.2, 4.2.1, 5.2.3, 7, 8.3.1, 9.7
Mutual Responsibility	6.2
Nonconforming Work, Acceptance of	12.3
Nonconforming Work, Rejection and Correction of	2.3.1, 4.3.5, 9.5.2, 9.8.2, 12, 13.7.1.3
Notice	2.3, 2.4, 3.2.1, 3.2.2, 3.7.3, 3.7.4, 3.9, 3.12.8, 3.12.9, 3.17, 4.3, 4.4.4, 4.5, 5.2.1, 5.3, 5.4.1.1, 8.2.2, 9.4.1, 9.5.1, 9.6.1, 9.7, 9.10, 10.1.2, 10.2.6, 11.1.3, 11.3, 12.2.2, 12.2.4, 13.3, 13.5.1, 13.5.2, 14
Notice, Written	2.3, 2.4, 3.9, 3.12.8, 3.12.9, 4.3, 4.4.4, 4.5, 5.2.1, 5.3, 5.4.1.1, 8.2.2, 9.4.1, 9.5.1, 9.7, 9.10, 10.1.2, 10.2.6, 11.1.3, 11.3, 12.2.2, 12.2.4, 13.3, 13.5.2, 14
Notice of Testing and Inspections	13.5.1, 13.5.2
Notice to Proceed	8.2.2
Notices, Permits, Fees and	2.2.3, 3.7, 3.13, 7.3.6.4, 10.2.2
Observations, Architect's On-Site	4.2.2, 4.2.5, 4.3.6, 9.4.2, 9.5.1, 9.10.1, 13.5
Observations, Contractor's	1.2.2, 3.2.2
Occupancy	9.6.6, 9.8.1, 9.9, 11.3.11
On-Site Inspections by the Architect	4.2.2, 4.2.9, 4.3.6, 9.4.2, 9.8.2, 9.9.2, 9.10.1
On-Site Observations by the Architect	4.2.2, 4.2.5, 4.3.6, 9.4.2, 9.5.1, 9.10.1, 13.5
Orders, Written	2.3, 3.9, 4.3.7, 7, 8.2.2, 11.3.9, 12.1, 12.2, 13.5.2, 14.3.1
OWNER	2
Owner, Definition of	2.1
Owner, Information and Services Required of the	2.1.2, 2.2, 4.3.4, 6, 9, 10.1.4, 11.2, 11.3, 13.5.1, 14.1.1.5, 14.1.3
Owner's Authority	3.8.1, 4.1.3, 4.2.9, 5.2.1, 5.2.4, 5.4.1, 7.3.1, 8.2.2, 9.3.1, 9.3.2, 11.4.1, 12.2.4, 13.5.2, 14.2, 14.3.1
Owner's Financial Capability	2.2.1, 14.1.1.5
Owner's Liability Insurance	11.2
Owner's Loss of Use Insurance	11.3.3
Owner's Relationship with Subcontractors	1.1.2, 5.2.1, 5.4.1, 9.6.4
Owner's Right to Carry Out the Work	2.4, 12.2.4, 14.2.2.2
Owner's Right to Clean Up	6.3

Owner's Right to Perform Construction and to Award Separate Contracts	6.1
Owner's Right to Stop the Work	2.3, 4.3.7
Owner's Right to Suspend the Work	14.3
Owner's Right to Terminate the Contract	14.2
Ownership and Use of Architect's Drawings, Specifications and Other Documents	1.1.1, 1.3, 2.2.5, 5.3
Partial Occupancy or Use	9.6.6, 9.9, 11.3.11
Patching, Cutting and	3.14, 6.2.6
Patents, Royalties and	3.17
Payment, Applications for	4.2.5, 9.2, 9.3, 9.4, 9.5.1, 9.8.3, 9.10.1, 9.10.3, 9.10.4, 14.2.4
Payment, Certificates for	4.2.5, 4.2.9, 9.3.3, 9.4, 9.5, 9.6.1, 9.6.6, 9.7.1, 9.8.3, 9.10.1, 9.10.3, 13.7, 14.1.1.3, 14.2.4
Payment, Failure of	4.3.7, 9.5.1.3, 9.7, 9.10.2, 14.1.1.3, 14.2.1.2
Payment, Final	4.2.1, 4.2.9, 4.3.2, 4.3.5, 9.10, 11.1.2, 11.1.3, 11.3.5, 12.3.1
Payment Bond, Performance Bond and	7.3.6.4, 9.10.3, 11.3.9, 11.4
Payments, Progress	4.3.4, 9.3, 9.6, 9.8.3, 9.10.3, 13.6, 14.2.3
PAYMENTS AND COMPLETION	9, 14
Payments to Subcontractors	5.4.2, 9.5.1.3, 9.6.2, 9.6.3, 9.6.4, 11.3.8, 14.2.1.2
PCB	10.1
Performance Bond and Payment Bond	7.3.6.4, 9.10.3, 11.3.9, 11.4
Permits, Fees and Notices	2.2.3, 3.7, 3.13, 7.3.6.4, 10.2.2
PERSONS AND PROPERTY, PROTECTION OF	10
Polychlorinated Biphenyl	10.1
Product Data, Definition of	3.12.2
Product Data and Samples, Shop Drawings	3.11, 3.12, 4.2.7
Progress and Completion	4.2.2, 4.3.4, 8.2
Progress Payments	4.3.4, 9.3, 9.6, 9.8.3, 9.10.3, 13.6, 14.2.3
Project, Definition of the	1.1.4
Project Manual, Definition of the	1.1.7
Project Manuals	2.2.5
Project Representatives	4.2.10
Property Insurance	10.2.5, 11.3
PROTECTION OF PERSONS AND PROPERTY	10
Regulations and Laws	1.3, 3.6, 3.7, 3.13, 4.1.1, 4.5.5, 4.5.7, 10.2.2, 11.1, 11.3, 13.1, 13.4, 13.5.1, 13.5.2, 13.6, 14
Rejection of Work	3.5.1, 4.2.6, 12.2
Releases of Waivers and Liens	9.10.2
Representations	1.2.2, 3.5.1, 3.12.7, 6.2.2, 8.2.1, 9.3.3, 9.4.2, 9.5.1, 9.8.2, 9.10.1
Representatives	2.1.1, 3.1.1, 3.9, 4.1.1, 4.2.1, 4.2.10, 5.1.1, 5.1.2, 13.2.1
Resolution of Claims and Disputes	4.4, 4.5
Responsibility for Those Performing the Work	3.3.2, 4.2.3, 6.1.3, 6.2, 10
Retainage	9.3.1, 9.6.2, 9.8.3, 9.9.1, 9.10.2, 9.10.3
Review of Contract Documents and Field Conditions by Contractor	1.2.2, 3.2, 3.7.3, 3.12.7
Review of Contractor's Submittals by	3.10.1, 3.10.2, 3.11, 3.12, 4.2.7, 4.2.9, 5.2.1, 5.2.3, 9.2, 9.8.2
Review of Shop Drawings, Product Data and Samples by Contractor	3.12.5
Rights and Remedies	1.1.2, 2.3, 2.4, 3.5.1, 3.15.2, 4.2.6, 4.3.6, 4.5, 5.3, 6.1, 6.3, 7.3.1, 8.3.1, 9.5.1, 9.7, 10.2.5, 10.3, 12.2.2, 12.2.4, 13.4, 14
Royalties and Patents	3.17

Rules and Notices for Arbitration	4.5.2
Safety of Persons and Property	10.2
Safety Precautions and Programs	4.2.3, 4.2.7, 10.1
Samples, Definition of	3.12.3
Samples, Shop Drawings, Product Data and	3.11, 3.12 , 4.2.7
Samples at the Site, Documents and	3.11
Schedule of Values	9.2 , 9.3.1
Schedules, Construction	3.10
Separate Contracts and Contractors	1.1.4, 3.14.2, 4.2.4, 4.5.5, 6, 11.3.7, 12.1.2, 12.2.5
Shop Drawings, Definition of	3.12.1
Shop Drawings, Product Data and Samples	3.11, 3.12 , 4.2.7
Site, Use of	3.13 , 6.1.1, 6.2.1
Site Inspections	1.2.2, 3.3.4, 4.2.2, 4.2.9, 4.3.6, 9.8.2, 9.10.1, 13.5
Site Visits, Architect's	4.2.2, 4.2.5, 4.2.9, 4.3.6, 9.4.2, 9.5.1, 9.8.2, 9.9.2, 9.10.1, 13.5
Special Inspections and Testing	4.2.6, 12.2.1, 13.5
Specifications, Definition of the	1.1.6
Specifications, The	1.1.1, 1.1.6 , 1.1.7, 1.2.4, 1.3, 3.11
Statutes of Limitations	4.5.4.2, 12.2.6, 13.7
Stopping the Work	2.3, 4.3.7, 9.7, 10.1.2, 10.3, 14.1
Stored Materials	6.2.1, 9.3.2, 10.2.1.2, 11.3.1.4, 12.2.4
Subcontractor, Definition of	5.1.1
SUBCONTRACTORS	5
Subcontractors, Work by	1.2.4, 3.3.2, 3.12.1, 4.2.3, 5.3, 5.4
Subcontractual Relations	5.3 , 5.4, 9.3.1.2, 9.6.2, 9.6.3, 9.6.4, 10.2.1, 11.3.7, 11.3.8, 14.1.1, 14.2.1.2, 14.3.2
Submittals	1.3, 3.2.3, 3.10, 3.11, 3.12, 4.2.7, 5.2.1, 5.2.3, 7.3.6, 9.2, 9.3.1, 9.8.2, 9.9.1, 9.10.2, 9.10.3, 10.1.2, 11.1.3
Subrogation, Waivers of	6.1.1, 11.3.5, 11.3.7
Substantial Completion	4.2.9, 4.3.5.2, 8.1.1, 8.1.3, 8.2.3, 9.8 , 9.9.1, 12.2.1, 12.2.2, 13.7
Substantial Completion, Definition of	9.8.1
Substitution of Subcontractors	5.2.3, 5.2.4
Substitution of the Architect	4.1.3
Substitutions of Materials	3.5.1
Sub-subcontractor, Definition of	5.1.2
Subsurface Conditions	4.3.6
Successors and Assigns	13.2
Superintendent	3.9 , 10.2.6
Supervision and Construction Procedures	1.2.4, 3.3 , 3.4, 4.2.3, 4.3.4, 6.1.3, 6.2.4, 7.1.3, 7.3.4, 8.2, 8.3.1, 10, 12, 14
Surety	4.4.1, 4.4.4, 5.4.1.2, 9.10.2, 9.10.3, 14.2.2
Surety, Consent of	9.9.1, 9.10.2, 9.10.3
Surveys	2.2.2, 3.18.3

Suspension by the Owner for Convenience	14.3
Suspension of the Work	4.3.7, 5.4.2, 14.1.1.4, 14.3
Suspension or Termination of the Contract	4.3.7, 5.4.1.1, 14
Taxes	3.6 , 7.3.6.4
Termination by the Contractor	14.1
Termination by the Owner for Cause	5.4.1.1, 14.2
Termination of the Architect	4.1.3
Termination of the Contractor	14.2.2
TERMINATION OR SUSPENSION OF THE CONTRACT	14
Tests and Inspections	3.3.3, 4.2.6, 4.2.9, 9.4.2, 12.2.1, 13.5
TIME	8
Time, Delays and Extensions of	4.3.8, 7.2.1, 8.3
Time Limits, Specific	2.1.2, 2.2.1, 2.4, 3.10, 3.11, 3.15.1, 4.2.1, 4.2.11, 4.3, 4.4, 4.5, 5.3, 5.4, 7.3.5, 7.3.9, 8.2, 9.2, 9.3.1, 9.3.3, 9.4.1, 9.6.1, 9.7, 9.8.2, 9.10.2, 11.1.3, 11.3.6, 11.3.10, 11.3.11, 12.2.2, 12.2.4, 12.2.6, 13.7, 14
Time Limits on Claims	4.3.2, 4.3.3 , 4.3.6, 4.3.9, 4.4, 4.5
Title to Work	9.3.2, 9.3.3
UNCOVERING AND CORRECTION OF WORK	12
Uncovering of Work	12.1
Unforeseen Conditions	4.3.6, 8.3.1, 10.1
Unit Prices	7.1.4, 7.3.3.2
Use of Documents	1.1.1, 1.3, 2.2.5, 3.12.7, 5.3
Use of Site	3.13 , 6.1.1, 6.2.1
Values, Schedule of	9.2 , 9.3.1
Waiver of Claims: Final Payment	4.3.5 , 4.5.1, 9.10.3
Waiver of Claims by the Architect	13.4.2
Waiver of Claims by the Contractor	9.10.4, 11.3.7, 13.4.2
Waiver of Claims by the Owner	4.3.5, 4.5.1, 9.9.3, 9.10.3, 11.3.3, 11.3.5, 11.3.7, 13.4.2
Waiver of Liens	9.10.2
Waivers of Subrogation	6.1.1, 11.3.5, 11.3.7
Warranty and Warranties	3.5 , 4.2.9, 4.3.5.3, 9.3.3, 9.8.2, 9.9.1, 12.2.2, 13.7.1.3
Weather Delays	4.3.8.2
When Arbitration May Be Demanded	4.5.4
Work, Definition of	1.1.3
Written Consent	1.3.1, 3.12.8, 3.14.2, 4.1.2, 4.3.4, 4.5.5, 9.3.2, 9.8.2, 9.9.1, 9.10.2, 9.10.3, 10.1.2, 10.1.3, 11.3.1, 11.3.1.4, 11.3.11, 13.2, 13.4.2
Written Interpretations	4.2.11, 4.2.12, 4.3.7
Written Notice	2.3, 2.4, 3.9, 3.12.8, 3.12.9, 4.3, 4.4.4, 4.5, 5.2.1, 5.3, 5.4.1.1, 8.2.2, 9.4.1, 9.5.1, 9.7, 9.10, 10.1.2, 10.2.6, 11.1.3, 11.3, 12.2.2, 12.2.4, 13.3 , 13.5.2, 14
Written Orders	2.3, 3.9, 4.3.7, 7, 8.2.2, 11.3.9, 12.1, 12.2, 13.5.2, 14.3.1

GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

ARTICLE 1

GENERAL PROVISIONS

1.1 BASIC DEFINITIONS

1.1.1 THE CONTRACT DOCUMENTS

The Contract Documents consist of the Agreement between Owner and Contractor (hereinafter the Agreement), Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, addenda issued prior to execution of the Contract, other documents listed in the Agreement and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include other documents such as bidding requirements (advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or portions of addenda relating to bidding requirements).

1.1.2 THE CONTRACT

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Architect and Contractor, (2) between the Owner and a Subcontractor or Sub-subcontractor or (3) between any persons or entities other than the Owner and Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

1.1.3 THE WORK

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

1.1.4 THE PROJECT

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner or by separate contractors.

1.1.5 THE DRAWINGS

The Drawings are the graphic and pictorial portions of the Contract Documents, wherever located and whenever issued, showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules and diagrams.

1.1.6 THE SPECIFICATIONS

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equip-

ment, construction systems, standards and workmanship for the Work, and performance of related services.

1.1.7 THE PROJECT MANUAL

The Project Manual is the volume usually assembled for the Work which may include the bidding requirements, sample forms, Conditions of the Contract and Specifications.

1.2 EXECUTION, CORRELATION AND INTENT

1.2.1 The Contract Documents shall be signed by the Owner and Contractor as provided in the Agreement. If either the Owner or Contractor or both do not sign all the Contract Documents, the Architect shall identify such unsigned Documents upon request.

1.2.2 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents.

1.2.3 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results.

1.2.4 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

1.2.5 Unless otherwise stated in the Contract Documents, words which have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

1.3 OWNERSHIP AND USE OF ARCHITECT'S DRAWINGS, SPECIFICATIONS AND OTHER DOCUMENTS

1.3.1 The Drawings, Specifications and other documents prepared by the Architect are instruments of the Architect's service through which the Work to be executed by the Contractor is described. The Contractor may retain one contract record set. Neither the Contractor nor any Subcontractor, Sub-subcontractor or material or equipment supplier shall own or claim a copyright in the Drawings, Specifications and other documents prepared by the Architect, and unless otherwise indicated the Architect shall be deemed the author of them and will retain all common law, statutory and other reserved rights, in addition to the copyright. All copies of them, except the Contractor's record set, shall be returned or suitably accounted for to the Architect, on request, upon completion of the Work. The Drawings, Specifications and other documents prepared by the Architect, and copies thereof furnished to the Contractor, are for use solely with respect to this Project. They are not to be used by the Contractor or any Subcontractor, Sub-subcontractor or material or equipment supplier on other projects or for additions to this Project outside the scope of the

Work without the specific written consent of the Owner and Architect. The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are granted a limited license to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by the Architect appropriate to and for use in the execution of their Work under the Contract Documents. All copies made under this license shall bear the statutory copyright notice, if any, shown on the Drawings, Specifications and other documents prepared by the Architect. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of the Architect's copyright or other reserved rights.

1.4 CAPITALIZATION

1.4.1 Terms capitalized in these General Conditions include those which are (1) specifically defined, (2) the titles of numbered articles and identified references to Paragraphs, Subparagraphs and Clauses in the document or (3) the titles of other documents published by the American Institute of Architects.

1.5 INTERPRETATION

1.5.1 In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

ARTICLE 2

OWNER

2.1 DEFINITION

2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The term "Owner" means the Owner or the Owner's authorized representative.

2.1.2 The Owner upon reasonable written request shall furnish to the Contractor in writing information which is necessary and relevant for the Contractor to evaluate, give notice of or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein at the time of execution of the Agreement and, within five days after any change, information of such change in title, recorded or unrecorded.

2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

2.2.1 The Owner shall, at the request of the Contractor, prior to execution of the Agreement and promptly from time to time thereafter, furnish to the Contractor reasonable evidence that financial arrangements have been made to fulfill the Owner's obligations under the Contract. *[Note: Unless such reasonable evidence were furnished on request prior to the execution of the Agreement, the prospective contractor would not be required to execute the Agreement or to commence the Work.]*

2.2.2 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site.

2.2.3 Except for permits and fees which are the responsibility of the Contractor under the Contract Documents, the Owner shall secure and pay for necessary approvals, easements, assess-

ments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

2.2.4 Information or services under the Owner's control shall be furnished by the Owner with reasonable promptness to avoid delay in orderly progress of the Work.

2.2.5 Unless otherwise provided in the Contract Documents, the Contractor will be furnished, free of charge, such copies of Drawings and Project Manuals as are reasonably necessary for execution of the Work.

2.2.6 The foregoing are in addition to other duties and responsibilities of the Owner enumerated herein and especially those in respect to Article 6 (Construction by Owner or by Separate Contractors), Article 9 (Payments and Completion) and Article 11 (Insurance and Bonds).

2.3 OWNER'S RIGHT TO STOP THE WORK

2.3.1 If the Contractor fails to correct Work which is not in accordance with the requirements of the Contract Documents as required by Paragraph 12.2 or persistently fails to carry out Work in accordance with the Contract Documents, the Owner, by written order signed personally or by an agent specifically so empowered by the Owner in writing, may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Subparagraph 6.1.3.

2.4 OWNER'S RIGHT TO CARRY OUT THE WORK

2.4.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a seven-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may after such seven-day period give the Contractor a second written notice to correct such deficiencies within a second seven-day period. If the Contractor within such second seven-day period after receipt of such second notice fails to commence and continue to correct any deficiencies, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the cost of correcting such deficiencies, including compensation for the Architect's additional services and expenses made necessary by such default, neglect or failure. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

ARTICLE 3

CONTRACTOR

3.1 DEFINITION

3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The term "Contractor" means the Contractor or the Contractor's authorized representative.

3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

3.2.1 The Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by the Owner pursuant to Subparagraph 2.2.2 and shall at once report to the Architect errors, inconsistencies or omissions discovered. The Contractor shall not be liable to the Owner or Architect for damage resulting from errors, inconsistencies or omissions in the Contract Documents unless the Contractor recognized such error, inconsistency or omission and knowingly failed to report it to the Architect. If the Contractor performs any construction activity knowing it involves a recognized error, inconsistency or omission in the Contract Documents without such notice to the Architect, the Contractor shall assume appropriate responsibility for such performance and shall bear an appropriate amount of the attributable costs for correction.

3.2.2 The Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor with the Contract Documents before commencing activities. Errors, inconsistencies or omissions discovered shall be reported to the Architect at once.

3.2.3 The Contractor shall perform the Work in accordance with the Contract Documents and submittals approved pursuant to Paragraph 3.12.

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless Contract Documents give other specific instructions concerning these matters.

3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons performing portions of the Work under a contract with the Contractor.

3.3.3 The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Contractor.

3.3.4 The Contractor shall be responsible for inspection of portions of Work already performed under this Contract to determine that such portions are in proper condition to receive subsequent Work.

3.4 LABOR AND MATERIALS

3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

3.4.2 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Contract. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.

3.5 WARRANTY

3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects not inherent in the quality required or permitted, and that the Work will conform with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

3.6 TAXES

3.6.1 The Contractor shall pay sales, consumer, use and similar taxes for the Work or portions thereof provided by the Contractor which are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

3.7 PERMITS, FEES AND NOTICES

3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit and other permits and governmental fees, licenses and inspections necessary for proper execution and completion of the Work which are customarily secured after execution of the Contract and which are legally required when bids are received or negotiations concluded.

3.7.2 The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations and lawful orders of public authorities bearing on performance of the Work.

3.7.3 It is not the Contractor's responsibility to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, building codes, and rules and regulations. However, if the Contractor observes that portions of the Contract Documents are at variance therewith, the Contractor shall promptly notify the Architect and Owner in writing, and necessary changes shall be accomplished by appropriate Modification.

3.7.4 If the Contractor performs Work knowing it to be contrary to laws, statutes, ordinances, building codes, and rules and regulations without such notice to the Architect and Owner, the Contractor shall assume full responsibility for such Work and shall bear the attributable costs.

3.8 ALLOWANCES

3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities against which the Contractor makes reasonable objection.

3.8.2 Unless otherwise provided in the Contract Documents:

- .1** materials and equipment under an allowance shall be selected promptly by the Owner to avoid delay in the Work;
- .2** allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;

- .3 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum and not in the allowances;
- .4 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Clause 3.8.2.2 and (2) changes in Contractor's costs under Clause 3.8.2.3.

3.9 SUPERINTENDENT

3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor. Important communications shall be confirmed in writing. Other communications shall be similarly confirmed on written request in each case.

3.10 CONTRACTOR'S CONSTRUCTION SCHEDULES

3.10.1 The Contractor, promptly after being awarded the Contract, shall prepare and submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work.

3.10.2 The Contractor shall prepare and keep current, for the Architect's approval, a schedule of submittals which is coordinated with the Contractor's construction schedule and allows the Architect reasonable time to review submittals.

3.10.3 The Contractor shall conform to the most recent schedules.

3.11 DOCUMENTS AND SAMPLES AT THE SITE

3.11.1 The Contractor shall maintain at the site for the Owner one record copy of the Drawings, Specifications, addenda, Change Orders and other Modifications, in good order and marked currently to record changes and selections made during construction, and in addition approved Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Architect and shall be delivered to the Architect for submittal to the Owner upon completion of the Work.

3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

3.12.1 Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

3.12.3 Samples are physical examples which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

3.12.4 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. The purpose of their submittal is to demonstrate for those portions of the Work for

which submittals are required the way the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents. Review by the Architect is subject to the limitations of Subparagraph 4.2.7.

3.12.5 The Contractor shall review, approve and submit to the Architect Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors. Submittals made by the Contractor which are not required by the Contract Documents may be returned without action.

3.12.6 The Contractor shall perform no portion of the Work requiring submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Architect. Such Work shall be in accordance with approved submittals.

3.12.7 By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents that the Contractor has determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

3.12.8 The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect in writing of such deviation at the time of submittal and the Architect has given written approval to the specific deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect's approval thereof.

3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Architect on previous submittals.

3.12.10 Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents.

3.12.11 When professional certification of performance criteria of materials, systems or equipment is required by the Contract Documents, the Architect shall be entitled to rely upon the accuracy and completeness of such calculations and certifications.

3.13 USE OF SITE

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

3.14 CUTTING AND PATCHING

3.14.1 The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly.

3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the

Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

3.15 CLEANING UP

3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work the Contractor shall remove from and about the Project waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials.

3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the cost thereof shall be charged to the Contractor.

3.16 ACCESS TO WORK

3.16.1 The Contractor shall provide the Owner and Architect access to the Work in preparation and progress wherever located.

3.17 ROYALTIES AND PATENTS

3.17.1 The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect.

3.18 INDEMNIFICATION

3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including loss of use resulting therefrom, but only to the extent caused in whole or in part by negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Paragraph 3.18.

3.18.2 In claims against any person or entity indemnified under this Paragraph 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under this Paragraph 3.18 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' or workmen's compensation acts, disability benefit acts or other employee benefit acts.

3.18.3 The obligations of the Contractor under this Paragraph 3.18 shall not extend to the liability of the Architect, the Archi-

tect's consultants, and agents and employees of any of them arising out of (1) the preparation or approval of maps, drawings, opinions, reports, surveys, Change Orders, designs or specifications, or (2) the giving of or the failure to give directions or instructions by the Architect, the Architect's consultants, and agents and employees of any of them provided such giving or failure to give is the primary cause of the injury or damage.

ARTICLE 4

ADMINISTRATION OF THE CONTRACT

4.1 ARCHITECT

4.1.1 The Architect is the person lawfully licensed to practice architecture or an entity lawfully practicing architecture identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The term "Architect" means the Architect or the Architect's authorized representative.

4.1.2 Duties, responsibilities and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified or extended without written consent of the Owner, Contractor and Architect. Consent shall not be unreasonably withheld.

4.1.3 In case of termination of employment of the Architect, the Owner shall appoint an architect against whom the Contractor makes no reasonable objection and whose status under the Contract Documents shall be that of the former architect.

4.1.4 Disputes arising under Subparagraphs 4.1.2 and 4.1.3 shall be subject to arbitration.

4.2 ARCHITECT'S ADMINISTRATION OF THE CONTRACT

4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents, and will be the Owner's representative (1) during construction, (2) until final payment is due and (3) with the Owner's concurrence, from time to time during the correction period described in Paragraph 12.2. The Architect will advise and consult with the Owner. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents, unless otherwise modified by written instrument in accordance with other provisions of the Contract.

4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction to become generally familiar with the progress and quality of the completed Work and to determine in general if the Work is being performed in a manner indicating that the Work, when completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check quality or quantity of the Work. On the basis of on-site observations as an architect, the Architect will keep the Owner informed of progress of the Work, and will endeavor to guard the Owner against defects and deficiencies in the Work.

4.2.3 The Architect will not have control over or charge of and will not be responsible for construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the Work, since these are solely the Contractor's responsibility as provided in Paragraph 3.3. The Architect will not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents. The Architect will not have control over or charge of and will not be responsible for acts or omissions of the Con-

tractor, Subcontractors, or their agents or employees, or of any other persons performing portions of the Work.

4.2.4 Communications Facilitating Contract Administration. Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate through the Architect. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner.

4.2.5 Based on the Architect's observations and evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

4.2.6 The Architect will have authority to reject Work which does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable for implementation of the intent of the Contract Documents, the Architect will have authority to require additional inspection or testing of the Work in accordance with Subparagraphs 13.5.2 and 13.5.3, whether or not such Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons performing portions of the Work.

4.2.7 The Architect will review and approve or take other appropriate action upon the Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken with such reasonable promptness as to cause no delay in the Work or in the activities of the Owner, Contractor or separate contractors, while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Paragraphs 3.3, 3.5 and 3.12. The Architect's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Architect, of any construction means, methods, techniques, sequences or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may authorize minor changes in the Work as provided in Paragraph 7.4.

4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion, will receive and forward to the Owner for the Owner's review and records written warranties and related documents required by the Contract and assembled by the Contractor, and will issue a final Certificate for Payment upon compliance with the requirements of the Contract Documents.

4.2.10 If the Owner and Architect agree, the Architect will provide one or more project representatives to assist in carrying

out the Architect's responsibilities at the site. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in an exhibit to be incorporated in the Contract Documents.

4.2.11 The Architect will interpret and decide matters concerning performance under and requirements of the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made with reasonable promptness and within any time limits agreed upon. If no agreement is made concerning the time within which interpretations required of the Architect shall be furnished in compliance with this Paragraph 4.2, then delay shall not be recognized on account of failure by the Architect to furnish such interpretations until 15 days after written request is made for them.

4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of and reasonably inferable from the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either and will not be liable for results of interpretations or decisions so rendered in good faith.

4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

4.3 CLAIMS AND DISPUTES

4.3.1 Definition. A Claim is a demand or assertion by one of the parties seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extension of time or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. Claims must be made by written notice. The responsibility to substantiate Claims shall rest with the party making the Claim.

4.3.2 Decision of Architect. Claims, including those alleging an error or omission by the Architect, shall be referred initially to the Architect for action as provided in Paragraph 4.4. A decision by the Architect, as provided in Subparagraph 4.4.4, shall be required as a condition precedent to arbitration or litigation of a Claim between the Contractor and Owner as to all such matters arising prior to the date final payment is due, regardless of (1) whether such matters relate to execution and progress of the Work or (2) the extent to which the Work has been completed. The decision by the Architect in response to a Claim shall not be a condition precedent to arbitration or litigation in the event (1) the position of Architect is vacant, (2) the Architect has not received evidence or has failed to render a decision within agreed time limits, (3) the Architect has failed to take action required under Subparagraph 4.4.4 within 30 days after the Claim is made, (4) 45 days have passed after the Claim has been referred to the Architect or (5) the Claim relates to a mechanic's lien.

4.3.3 Time Limits on Claims. Claims by either party must be made within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later. Claims must be made by written notice. An additional Claim made after the initial Claim has been implemented by Change Order will not be considered unless submitted in a timely manner.

4.3.4 Continuing Contract Performance. Pending final resolution of a Claim including arbitration, unless otherwise agreed in writing the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

4.3.5 Waiver of Claims: Final Payment. The making of final payment shall constitute a waiver of Claims by the Owner except those arising from:

1. liens, Claims, security interests or encumbrances arising out of the Contract and unsettled;
2. failure of the Work to comply with the requirements of the Contract Documents; or
3. terms of special warranties required by the Contract Documents.

4.3.6 Claims for Concealed or Unknown Conditions. If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then notice by the observing party shall be given to the other party promptly before conditions are disturbed and in no event later than 21 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall so notify the Owner and Contractor in writing, stating the reasons. Claims by either party in opposition to such determination must be made within 21 days after the Architect has given notice of the decision. If the Owner and Contractor cannot agree on an adjustment in the Contract Sum or Contract Time, the adjustment shall be referred to the Architect for initial determination, subject to further proceedings pursuant to Paragraph 4.4.

4.3.7 Claims for Additional Cost. If the Contractor wishes to make Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Paragraph 10.3. If the Contractor believes additional cost is involved for reasons including but not limited to (1) a written interpretation from the Architect, (2) an order by the Owner to stop the Work where the Contractor was not at fault, (3) a written order for a minor change in the Work issued by the Architect, (4) failure of payment by the Owner, (5) termination of the Contract by the Owner, (6) Owner's suspension or (7) other reasonable grounds, Claim shall be filed in accordance with the procedure established herein.

4.3.8 Claims for Additional Time

4.3.8.1 If the Contractor wishes to make Claim for an increase in the Contract Time, written notice as provided herein shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay only one Claim is necessary.

4.3.8.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data

substantiating that weather conditions were abnormal for the period of time and could not have been reasonably anticipated, and that weather conditions had an adverse effect on the scheduled construction.

4.3.9 Injury or Damage to Person or Property. If either party to the Contract suffers injury or damage to person or property because of an act or omission of the other party, of any of the other party's employees or agents, or of others for whose acts such party is legally liable, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after first observance. The notice shall provide sufficient detail to enable the other party to investigate the matter. If a Claim for additional cost or time related to this Claim is to be asserted, it shall be filed as provided in Subparagraphs 4.3.7 or 4.3.8.

4.4 RESOLUTION OF CLAIMS AND DISPUTES

4.4.1 The Architect will review Claims and take one or more of the following preliminary actions within ten days of receipt of a Claim: (1) request additional supporting data from the claimant, (2) submit a schedule to the parties indicating when the Architect expects to take action, (3) reject the Claim in whole or in part, stating reasons for rejection, (4) recommend approval of the Claim by the other party or (5) suggest a compromise. The Architect may also, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim.

4.4.2 If a Claim has been resolved, the Architect will prepare or obtain appropriate documentation.

4.4.3 If a Claim has not been resolved, the party making the Claim shall, within ten days after the Architect's preliminary response, take one or more of the following actions: (1) submit additional supporting data requested by the Architect, (2) modify the initial Claim or (3) notify the Architect that the initial Claim stands.

4.4.4 If a Claim has not been resolved after consideration of the foregoing and of further evidence presented by the parties or requested by the Architect, the Architect will notify the parties in writing that the Architect's decision will be made within seven days, which decision shall be final and binding on the parties but subject to arbitration. Upon expiration of such time period, the Architect will render to the parties the Architect's written decision relative to the Claim, including any change in the Contract Sum or Contract Time or both. If there is a surety and there appears to be a possibility of a Contractor's default, the Architect may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

4.5 ARBITRATION

4.5.1 Controversies and Claims Subject to Arbitration. Any controversy or Claim arising out of or related to the Contract, or the breach thereof, shall be settled by arbitration in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association, and judgment upon the award rendered by the arbitrator or arbitrators may be entered in any court having jurisdiction thereof, except controversies or Claims relating to aesthetic effect and except those waived as provided for in Subparagraph 4.3.5. Such controversies or Claims upon which the Architect has given notice and rendered a decision as provided in Subparagraph 4.4.4 shall be subject to arbitration upon written demand of either party. Arbitration may be commenced when 45 days have passed after a Claim has been referred to the Architect as provided in Paragraph 4.3 and no decision has been rendered.

4.5.2 Rules and Notices for Arbitration. Claims between the Owner and Contractor not resolved under Paragraph 4.4 shall, if subject to arbitration under Subparagraph 4.5.1, be decided by arbitration in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association currently in effect, unless the parties mutually agree otherwise. Notice of demand for arbitration shall be filed in writing with the other party to the Agreement between the Owner and Contractor and with the American Arbitration Association, and a copy shall be filed with the Architect.

4.5.3 Contract Performance During Arbitration. During arbitration proceedings, the Owner and Contractor shall comply with Subparagraph 4.3.4.

4.5.4 When Arbitration May Be Demanded. Demand for arbitration of any Claim may not be made until the earlier of (1) the date on which the Architect has rendered a final written decision on the Claim, (2) the tenth day after the parties have presented evidence to the Architect or have been given reasonable opportunity to do so, if the Architect has not rendered a final written decision by that date, or (3) any of the five events described in Subparagraph 4.3.2.

4.5.4.1 When a written decision of the Architect states that (1) the decision is final but subject to arbitration and (2) a demand for arbitration of a Claim covered by such decision must be made within 30 days after the date on which the party making the demand receives the final written decision, then failure to demand arbitration within said 30 days' period shall result in the Architect's decision becoming final and binding upon the Owner and Contractor. If the Architect renders a decision after arbitration proceedings have been initiated, such decision may be entered as evidence, but shall not supersede arbitration proceedings unless the decision is acceptable to all parties concerned.

4.5.4.2 A demand for arbitration shall be made within the time limits specified in Subparagraphs 4.5.1 and 4.5.4 and Clause 4.5.4.1 as applicable, and in other cases within a reasonable time after the Claim has arisen, and in no event shall it be made after the date when institution of legal or equitable proceedings based on such Claim would be barred by the applicable statute of limitations as determined pursuant to Paragraph 13.7.

4.5.5 Limitation on Consolidation or Joinder. No arbitration arising out of or relating to the Contract Documents shall include, by consolidation or joinder or in any other manner, the Architect, the Architect's employees or consultants, except by written consent containing specific reference to the Agreement and signed by the Architect, Owner, Contractor and any other person or entity sought to be joined. No arbitration shall include, by consolidation or joinder or in any other manner, parties other than the Owner, Contractor, a separate contractor as described in Article 6 and other persons substantially involved in a common question of fact or law whose presence is required if complete relief is to be accorded in arbitration. No person or entity other than the Owner, Contractor or a separate contractor as described in Article 6 shall be included as an original third party or additional third party to an arbitration whose interest or responsibility is insubstantial. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of a dispute not described therein or with a person or entity not named or described therein. The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

4.5.6 Claims and Timely Assertion of Claims. A party who files a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded. When a party fails to include a Claim through oversight, inadvertence or excusable neglect, or when a Claim has matured or been acquired subsequently, the arbitrator or arbitrators may permit amendment.

4.5.7 Judgment on Final Award. The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

ARTICLE 5

SUBCONTRACTORS

5.1 DEFINITIONS

5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a separate contractor or subcontractors of a separate contractor.

5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

5.2.1 Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. The Architect will promptly reply to the Contractor in writing stating whether or not the Owner or the Architect, after due investigation, has reasonable objection to any such proposed person or entity. Failure of the Owner or Architect to reply promptly shall constitute notice of no reasonable objection.

5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. The Contract Sum shall be increased or decreased by the difference in cost occasioned by such change and an appropriate Change Order shall be issued. However, no increase in the Contract Sum shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

5.2.4 The Contractor shall not change a Subcontractor, person or entity previously selected if the Owner or Architect makes reasonable objection to such change.

5.3 SUBCONTRACTUAL RELATIONS

5.3.1 By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by these Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement which may be at variance with the Contract Documents. Subcontractors shall similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

5.4 CONTINGENT ASSIGNMENT OF SUBCONTRACTS

5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner provided that:

- 1** assignment is effective only after termination of the Contract by the Owner for cause pursuant to Paragraph 14.2 and only for those subcontract agreements which the Owner accepts by notifying the Subcontractor in writing; and
- 2** assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

5.4.2 If the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted.

ARTICLE 6

CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

6.1 OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

6.1.1 The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided elsewhere in the Contract Documents.

6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each separate contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the Owner in reviewing their construction schedules when directed to do so. The Contractor shall make any revisions to the construction schedule and Contract Sum deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, separate contractors and the Owner until subsequently revised.

6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces, the Owner shall be deemed to be subject to the same obligations and to have the same rights which apply to the Contractor under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6 and Articles 10, 11 and 12.

6.2 MUTUAL RESPONSIBILITY

6.2.1 The Contractor shall afford the Owner and separate contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Architect apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that the Owner's or separate contractors' completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then reasonably discoverable.

6.2.3 Costs caused by delays or by improperly timed activities or defective construction shall be borne by the party responsible therefor.

6.2.4 The Contractor shall promptly remedy damage wrongfully caused by the Contractor to completed or partially completed construction or to property of the Owner or separate contractors as provided in Subparagraph 10.2.5.

6.2.5 Claims and other disputes and matters in question between the Contractor and a separate contractor shall be subject to the provisions of Paragraph 4.3 provided the separate contractor has reciprocal obligations.

6.2.6 The Owner and each separate contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Paragraph 3.14.

6.3 OWNER'S RIGHT TO CLEAN UP

6.3.1 If a dispute arises among the Contractor, separate contractors and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish as described in Paragraph 3.15, the Owner may clean up and allocate the cost among those responsible as the Architect determines to be just.

ARTICLE 7

CHANGES IN THE WORK

7.1 CHANGES

7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor and Architect; a Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor; an order for a minor change in the Work may be issued by the Architect alone.

7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents, and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive or order for a minor change in the Work.

7.1.4 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are so changed in a proposed Change Order or Construction Change Directive that application of such unit prices to quantities of Work proposed will cause substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

7.2 CHANGE ORDERS

7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor and Architect, stating their agreement upon all of the following:

- .1 a change in the Work;
- .2 the amount of the adjustment in the Contract Sum, if any; and
- .3 the extent of the adjustment in the Contract Time, if any.

7.2.2 Methods used in determining adjustments to the Contract Sum may include those listed in Subparagraph 7.3.3.

7.3 CONSTRUCTION CHANGE DIRECTIVES

7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work and stating a proposed basis for adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- .1 mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 unit prices stated in the Contract Documents or subsequently agreed upon;

.3 cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or

.4 as provided in Subparagraph 7.3.6.

7.3.4 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

7.3.5 A Construction Change Directive signed by the Contractor indicates the agreement of the Contractor therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

7.3.6 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the method and the adjustment shall be determined by the Architect on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, a reasonable allowance for overhead and profit. In such case, and also under Clause 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Subparagraph 7.3.6 shall be limited to the following:

- .1 costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers' or workmen's compensation insurance;
- .2 costs of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;
- .3 rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- .4 costs of premiums for all bonds and insurance, permit fees, and sales, use or similar taxes related to the Work; and
- .5 additional costs of supervision and field office personnel directly attributable to the change.

7.3.7 Pending final determination of cost to the Owner, amounts not in dispute may be included in Applications for Payment. The amount of credit to be allowed by the Contractor to the Owner for a deletion or change which results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

7.3.8 If the Owner and Contractor do not agree with the adjustment in Contract Time or the method for determining it, the adjustment or the method shall be referred to the Architect for determination.

7.3.9 When the Owner and Contractor agree with the determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and shall be recorded by preparation and execution of an appropriate Change Order.

7.4 MINOR CHANGES IN THE WORK

7.4.1 The Architect will have authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes shall be effected by written order and shall be binding on the Owner and Contractor. The Contractor shall carry out such written orders promptly.

ARTICLE 8

TIME

8.1 DEFINITIONS

8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

8.1.2 The date of commencement of the Work is the date established in the Agreement. The date shall not be postponed by the failure to act of the Contractor or of persons or entities for whom the Contractor is responsible.

8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Paragraph 9.8.

8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

8.2 PROGRESS AND COMPLETION

8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the effective date of insurance required by Article 11 to be furnished by the Contractor. The date of commencement of the Work shall not be changed by the effective date of such insurance. Unless the date of commencement is established by a notice to proceed given by the Owner, the Contractor shall notify the Owner in writing not less than five days or other agreed period before commencing the Work to permit the timely filing of mortgages, mechanic's liens and other security interests.

8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

8.3 DELAYS AND EXTENSIONS OF TIME

8.3.1 If the Contractor is delayed at any time in progress of the Work by an act or neglect of the Owner or Architect, or of an employee of either, or of a separate contractor employed by the Owner, or by changes ordered in the Work, or by labor disputes, fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the Contractor's control, or by delay authorized by the Owner pending arbitration, or by other causes which the Architect determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect may determine.

8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Paragraph 4.3.

8.3.3 This Paragraph 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9

PAYMENTS AND COMPLETION

9.1 CONTRACT SUM

9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

9.2 SCHEDULE OF VALUES

9.2.1 Before the first Application for Payment, the Contractor shall submit to the Architect a schedule of values allocated to various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment.

9.3 APPLICATIONS FOR PAYMENT

9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment for operations completed in accordance with the schedule of values. Such application 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 reflecting retainage if provided for elsewhere in the Contract Documents.

9.3.1.1 Such applications may include requests for payment on account of changes in the Work which have been properly authorized by Construction Change Directives but not yet included in Change Orders.

9.3.1.2 Such applications may not include requests for payment of amounts the Contractor does not intend to pay to a Subcontractor or material supplier because of a dispute or other reason.

9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include applicable insurance, storage and transportation to the site for such materials and equipment stored off the site.

9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

9.4 CERTIFICATES FOR PAYMENT

9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either issue to the

Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor and Owner in writing of the Architect's reasons for withholding certification in whole or in part as provided in Subparagraph 9.5.1.

9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's observations at the site and the data comprising the Application for Payment, that the Work has progressed to the point indicated and that, to the best of the Architect's knowledge, information and belief, quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to minor deviations from the Contract Documents correctable prior to completion and to specific qualifications expressed by the Architect. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

9.5 DECISIONS TO WITHHOLD CERTIFICATION

9.5.1 The Architect may decide not to certify payment and may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Subparagraph 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Subparagraph 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also decide not to certify payment or, because of subsequently discovered evidence or subsequent observations, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss because of:

- .1 defective Work not remedied;
- .2 third party claims filed or reasonable evidence indicating probable filing of such claims;
- .3 failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;
- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage to the Owner or another contractor;
- .6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- .7 persistent failure to carry out the Work in accordance with the Contract Documents.

9.5.2 When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.

9.6 PROGRESS PAYMENTS

9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

9.6.2 The Contractor shall promptly pay each Subcontractor, upon receipt of payment from the Owner, out of the amount paid to the Contractor on account of such Subcontractor's portion of the Work, the amount to which said Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of such Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in similar manner.

9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

9.6.4 Neither the Owner nor Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor except as may otherwise be required by law.

9.6.5 Payment to material suppliers shall be treated in a manner similar to that provided in Subparagraphs 9.6.2, 9.6.3 and 9.6.4.

9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

9.7 FAILURE OF PAYMENT

9.7.1 If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents the amount certified by the Architect or awarded by arbitration, then the Contractor may, upon seven additional days' written notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shut-down, delay and start-up, which shall be accomplished as provided in Article 7.

9.8 SUBSTANTIAL COMPLETION

9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so the Owner can occupy or utilize the Work for its intended use.

9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected. The Contractor shall proceed promptly to complete and correct items on the list. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents. Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or design-

nated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not in accordance with the requirements of the Contract Documents, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. The Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion. When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion which shall establish the date of Substantial Completion, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion. The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate.

9.8.3 Upon Substantial Completion of the Work or designated portion thereof and upon application by the Contractor and certification by the Architect, the Owner shall make payment, reflecting adjustment in retainage, if any, for such Work or portion thereof as provided in the Contract Documents.

9.9 PARTIAL OCCUPANCY OR USE

9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer as required under Subparagraph 11.3.11 and authorized by public authorities having jurisdiction over the Work. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Subparagraph 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

9.10 FINAL COMPLETION AND FINAL PAYMENT

9.10.1 Upon receipt of written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make

such inspection and, when the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's observations and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in said final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Subparagraph 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be cancelled or allowed to expire until at least 30 days' prior written notice has been given to the Owner, (3) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment and (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien. If such lien remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees.

9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of claims. The making of final payment shall constitute a waiver of claims by the Owner as provided in Subparagraph 4.3.5.

9.10.4 Acceptance of final payment by the Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment. Such waivers shall be in addition to the waiver described in Subparagraph 4.3.5.

ARTICLE 10

PROTECTION OF PERSONS AND PROPERTY

10.1 SAFETY PRECAUTIONS AND PROGRAMS

10.1.1 The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract.

10.1.2 In the event the Contractor encounters on the site material reasonably believed to be asbestos or polychlorinated biphenyl (PCB) which has not been rendered harmless, the Contractor shall immediately stop Work in the area affected and report the condition to the Owner and Architect in writing. The Work in the affected area shall not thereafter be resumed except by written agreement of the Owner and Contractor if in fact the material is asbestos or polychlorinated biphenyl (PCB) and has not been rendered harmless. The Work in the affected area shall be resumed in the absence of asbestos or polychlorinated biphenyl (PCB), or when it has been rendered harmless, by written agreement of the Owner and Contractor, or in accordance with final determination by the Architect on which arbitration has not been demanded, or by arbitration under Article 4.

10.1.3 The Contractor shall not be required pursuant to Article 7 to perform without consent any Work relating to asbestos or polychlorinated biphenyl (PCB).

10.1.4 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Architect, Architect's consultants and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material is asbestos or polychlorinated biphenyl (PCB) and has not been rendered harmless, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including loss of use resulting therefrom, but only to the extent caused in whole or in part by negligent acts or omissions of the Owner, anyone directly or indirectly employed by the Owner or anyone for whose acts the Owner may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Subparagraph 10.1.4.

10.2 SAFETY OF PERSONS AND PROPERTY

10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to:

- .1 employees on the Work and other persons who may be affected thereby;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor's Subcontractors or Sub-subcontractors; and
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

10.2.2 The Contractor shall give notices and comply with applicable laws, ordinances, rules, regulations and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury or loss.

10.2.3 The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent sites and utilities.

10.2.4 When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Clauses 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Clauses 10.2.1.2 and 10.2.1.3, except damage or loss attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Paragraph 3.18.

10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

10.2.7 The Contractor shall not load or permit any part of the construction or site to be loaded so as to endanger its safety.

10.3 EMERGENCIES

10.3.1 In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Paragraph 4.3 and Article 7.

ARTICLE 11

INSURANCE AND BONDS

11.1 CONTRACTOR'S LIABILITY INSURANCE

11.1.1 The Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor's operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

- .1 claims under workers' or workmen's compensation, disability benefit and other similar employee benefit acts which are applicable to the Work to be performed;

2. claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;
3. claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;
4. claims for damages insured by usual personal injury liability coverage which are sustained (1) by a person as a result of an offense directly or indirectly related to employment of such person by the Contractor, or (2) by another person;
5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom;
6. claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle; and
7. claims involving contractual liability insurance applicable to the Contractor's obligations under Paragraph 3.18.

11.1.2 The insurance required by Subparagraph 11.1.1 shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from date of commencement of the Work until date of final payment and termination of any coverage required to be maintained after final payment.

11.1.3 Certificates of Insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work. These Certificates and the insurance policies required by this Paragraph 11.1 shall contain a provision that coverages afforded under the policies will not be cancelled or allowed to expire until at least 30 days' prior written notice has been given to the Owner. If any of the foregoing insurance coverages are required to remain in force after final payment and are reasonably available, an additional certificate evidencing continuation of such coverage shall be submitted with the final Application for Payment as required by Subparagraph 9.10.2. Information concerning reduction of coverage shall be furnished by the Contractor with reasonable promptness in accordance with the Contractor's information and belief.

11.2 OWNER'S LIABILITY INSURANCE

11.2.1 The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance. Optionally, the Owner may purchase and maintain other insurance for self-protection against claims which may arise from operations under the Contract. The Contractor shall not be responsible for purchasing and maintaining this optional Owner's liability insurance unless specifically required by the Contract Documents.

11.3 PROPERTY INSURANCE

11.3.1 Unless otherwise provided, the Owner shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, property insurance in the amount of the initial Contract Sum as well as subsequent modifications thereto for the entire Work at the site on a replacement cost basis without voluntary deductibles. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Paragraph 9.10 or until no person or entity

other than the Owner has an insurable interest in the property required by this Paragraph 11.3 to be covered, whichever is earlier. This insurance shall include interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Work.

11.3.1.1 Property insurance shall be on an all-risk policy form and shall insure against the perils of fire and extended coverage and physical loss or damage including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, false-work, temporary buildings and debris removal including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for Architect's services and expenses required as a result of such insured loss. Coverage for other perils shall not be required unless otherwise provided in the Contract Documents.

11.3.1.2 If the Owner does not intend to purchase such property insurance required by the Contract and with all of the coverages in the amount described above, the Owner shall so inform the Contractor in writing prior to commencement of the Work. The Contractor may then effect insurance which will protect the interests of the Contractor, Subcontractors and Sub-subcontractors in the Work, and by appropriate Change Order the cost thereof shall be charged to the Owner. If the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain insurance as described above, without so notifying the Contractor, then the Owner shall bear all reasonable costs properly attributable thereto.

11.3.1.3 If the property insurance requires minimum deductibles and such deductibles are identified in the Contract Documents, the Contractor shall pay costs not covered because of such deductibles. If the Owner or insurer increases the required minimum deductibles above the amounts so identified or if the Owner elects to purchase this insurance with voluntary deductible amounts, the Owner shall be responsible for payment of the additional costs not covered because of such increased or voluntary deductibles. If deductibles are not identified in the Contract Documents, the Owner shall pay costs not covered because of deductibles.

11.3.1.4 Unless otherwise provided in the Contract Documents, this property insurance shall cover portions of the Work stored off the site after written approval of the Owner at the value established in the approval, and also portions of the Work in transit.

11.3.2 Boiler and Machinery Insurance. The Owner shall purchase and maintain boiler and machinery insurance required by the Contract Documents or by law, which shall specifically cover such insured objects during installation and until final acceptance by the Owner; this insurance shall include interests of the Owner, Contractor, Subcontractors and Sub-subcontractors in the Work, and the Owner and Contractor shall be named insureds.

11.3.3 Loss of Use Insurance. The Owner, at the Owner's option, may purchase and maintain such insurance as will insure the Owner against loss of use of the Owner's property due to fire or other hazards, however caused. The Owner waives all rights of action against the Contractor for loss of use of the Owner's property, including consequential losses due to fire or other hazards however caused.

11.3.4 If the Contractor requests in writing that insurance for risks other than those described herein or for other special hazards be included in the property insurance policy, the Owner shall, if possible, include such insurance, and the cost thereof shall be charged to the Contractor by appropriate Change Order.

11.3.5 If during the Project construction period the Owner insures properties, real or personal or both, adjoining or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, the Owner shall waive all rights in accordance with the terms of Subparagraph 11.3.7 for damages caused by fire or other perils covered by this separate property insurance. All separate policies shall provide this waiver of subrogation by endorsement or otherwise.

11.3.6 Before an exposure to loss may occur, the Owner shall file with the Contractor a copy of each policy that includes insurance coverages required by this Paragraph 11.3. Each policy shall contain all generally applicable conditions, definitions, exclusions and endorsements related to this Project. Each policy shall contain a provision that the policy will not be cancelled or allowed to expire until at least 30 days' prior written notice has been given to the Contractor.

11.3.7 Waivers of Subrogation. The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents and employees, each of the other, and (2) the Architect, Architect's consultants, separate contractors described in Article 6, if any, and any of their subcontractors, sub-subcontractors, agents and employees, for damages caused by fire or other perils to the extent covered by property insurance obtained pursuant to this Paragraph 11.3 or other property insurance applicable to the Work, except such rights as they have to proceeds of such insurance held by the Owner as fiduciary. The Owner or Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate contractors described in Article 6, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

11.3.8 A loss insured under Owner's property insurance shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Subparagraph 11.3.10. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner.

11.3.9 If required in writing by a party in interest, the Owner as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Owner's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Owner shall deposit in a separate account proceeds so received, which the Owner shall distribute in accordance with such agreement as the parties in interest may reach, or in accordance with an arbitration award in which case the procedure shall be as provided in Paragraph 4.5. If after such loss no other special agreement is made, replacement of damaged property shall be covered by appropriate Change Order.

11.3.10 The Owner as fiduciary shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within five days after occurrence of loss to the Owner's exercise of this power; if such objection be made, arbitrators shall be chosen as provided in Paragraph 4.5. The Owner as fiduciary shall, in that case, make settlement with insurers in accordance with directions of such arbitrators. If distribution of insurance proceeds by arbitration is required, the arbitrators will direct such distribution.

11.3.11 Partial occupancy or use in accordance with Paragraph 9.9 shall not commence until the insurance company or companies providing property insurance have consented to such partial occupancy or use by endorsement or otherwise. The Owner and the Contractor shall take reasonable steps to obtain consent of the insurance company or companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse or reduction of insurance.

11.4 PERFORMANCE BOND AND PAYMENT BOND

11.4.1 The Owner shall have the right to require the Contractor to furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract Documents on the date of execution of the Contract.

11.4.2 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall permit a copy to be made.

ARTICLE 12

UNCOVERING AND CORRECTION OF WORK

12.1 UNCOVERING OF WORK

12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if required in writing by the Architect, be uncovered for the Architect's observation and be replaced at the Contractor's expense without change in the Contract Time.

12.1.2 If a portion of the Work has been covered which the Architect has not specifically requested to observe prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be charged to the Owner. 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 shall be responsible for payment of such costs.

12.2 CORRECTION OF WORK

12.2.1 The Contractor shall promptly correct Work rejected by the Architect 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. The Contractor shall bear costs of correcting such rejected Work, including additional testing and inspections and compensation for the Architect's services and expenses made necessary thereby.

12.2.2 If, within one year after the date of Substantial Completion of the Work or designated portion thereof, or after the date

for commencement of warranties established under Subparagraph 9.9.1, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. This period of one year shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual performance of the Work. This obligation under this Subparagraph 12.2.2 shall survive acceptance of the Work under the Contract and termination of the Contract. The Owner shall give such notice promptly after discovery of the condition.

12.2.3 The Contractor shall remove from the site portions of the Work which are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

12.2.4 If the Contractor fails to correct nonconforming Work within a reasonable time, the Owner may correct it in accordance with Paragraph 2.4. If the Contractor does not proceed with correction of such nonconforming Work within a reasonable time fixed by written notice from the Architect, the Owner may remove it and store the salvable materials or equipment at the Contractor's expense. If the Contractor does not pay costs of such removal and storage within ten days after written notice, the Owner may upon ten additional days' written notice sell such materials and equipment at auction or at private sale and shall account for the proceeds thereof, after deducting costs and damages that should have been borne by the Contractor, including compensation for the Architect's services and expenses made necessary thereby. If such proceeds of sale do not cover costs which the Contractor should have borne, the Contract Sum shall be reduced by the deficiency. If payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Owner.

12.2.5 The Contractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, of the Owner or separate contractors caused by the Contractor's correction or removal of Work which is not in accordance with the requirements of the Contract Documents.

12.2.6 Nothing contained in this Paragraph 12.2 shall be construed to establish a period of limitation with respect to other obligations which the Contractor might have under the Contract Documents. Establishment of the time period of one year as described in Subparagraph 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

12.3 ACCEPTANCE OF NONCONFORMING WORK

12.3.1 If the Owner prefers to accept Work which is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13

MISCELLANEOUS PROVISIONS

13.1 GOVERNING LAW

13.1.1 The Contract shall be governed by the law of the place where the Project is located.

13.2 SUCCESSORS AND ASSIGNS

13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to the other party hereto and to partners, successors, assigns and legal representatives of such other party in respect to covenants, agreements and obligations contained in the Contract Documents. Neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make such an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

13.3 WRITTEN NOTICE

13.3.1 Written notice shall be deemed to have been duly served if delivered in person to the individual or a member of the firm or entity or to an officer of the corporation for which it was intended, or if delivered at or sent by registered or certified mail to the last business address known to the party giving notice.

13.4 RIGHTS AND REMEDIES

13.4.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed or available by law.

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

13.5 TESTS AND INSPECTIONS

13.5.1 Tests, inspections and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, regulations or orders of public authorities having jurisdiction shall be made at an appropriate time. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so the Architect may observe such procedures. The Owner shall bear costs of tests, inspections or approvals which do not become requirements until after bids are received or negotiations concluded.

13.5.2 If the Architect, Owner or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Subparagraph 13.5.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so the Architect may observe such procedures.

The Owner shall bear such costs except as provided in Subparagraph 13.5.3.

13.5.3 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 shall bear all costs made necessary by such failure including those of repeated procedures and compensation for the Architect's services and expenses.

13.5.4 Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

13.5.5 If the Architect is to observe tests, inspections or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

13.5.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

13.6 INTEREST

13.6.1 Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at such rate as the parties may agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

13.7 COMMENCEMENT OF STATUTORY LIMITATION PERIOD

13.7.1 As between the Owner and Contractor:

- .1 Before Substantial Completion.** As to acts or failures to act occurring prior to the relevant date of Substantial Completion, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than such date of Substantial Completion;
- .2 Between Substantial Completion and Final Certificate for Payment.** As to acts or failures to act occurring subsequent to the relevant date of Substantial Completion and prior to issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of issuance of the final Certificate for Payment; and
- .3 After Final Certificate for Payment.** As to acts or failures to act occurring after the relevant date of issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of any act or failure to act by the Contractor pursuant to any warranty provided under Paragraph 3.5, the date of any correction of the Work or failure to correct the Work by the Contractor under Paragraph 12.2, or the date of actual commission of any other act or failure to perform any duty or obligation by the Contractor or Owner, whichever occurs last.

ARTICLE 14

TERMINATION OR SUSPENSION OF THE CONTRACT

14.1 TERMINATION BY THE CONTRACTOR

14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor, for any of the following reasons:

- .1** issuance of an order of a court or other public authority having jurisdiction;
- .2** an act of government, such as a declaration of national emergency, making material unavailable;
- .3** because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Subparagraph 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents;
- .4** if repeated suspensions, delays or interruptions by the Owner as described in Paragraph 14.3 constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less; or
- .5** the Owner has failed to furnish to the Contractor promptly, upon the Contractor's request, reasonable evidence as required by Subparagraph 2.2.1.

14.1.2 If one of the above reasons exists, the Contractor may, upon seven additional days' written notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed and for proven loss with respect to materials, equipment, tools, and construction equipment and machinery, including reasonable overhead, profit and damages.

14.1.3 If the Work is stopped for a period of 60 days through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor because the Owner has persistently failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' written notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Subparagraph 14.1.2.

14.2 TERMINATION BY THE OWNER FOR CAUSE

14.2.1 The Owner may terminate the Contract if the Contractor:

- .1** persistently or repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- .2** fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
- .3** persistently disregards laws, ordinances, or rules, regulations or orders of a public authority having jurisdiction; or
- .4** otherwise is guilty of substantial breach of a provision of the Contract Documents.

14.2.2 When any of the above reasons exist, the Owner, upon certification by the Architect that sufficient cause exists to jus-

tify such action, may without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- .1 take possession of the site and of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 accept assignment of subcontracts pursuant to Paragraph 5.4; and
- .3 finish the Work by whatever reasonable method the Owner may deem expedient.

14.2.3 When the Owner terminates the Contract for one of the reasons stated in Subparagraph 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, such excess shall be paid to the Contractor. If such costs exceed the unpaid balance, the Contractor shall pay the difference to the

Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Architect, upon application, and this obligation for payment shall survive termination of the Contract.

14.3 SUSPENSION BY THE OWNER FOR CONVENIENCE

14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work in whole or in part for such period of time as the Owner may determine.

14.3.2 An adjustment shall be made for increases in the cost of performance of the Contract, including profit on the increased cost of performance, caused by suspension, delay or interruption. No adjustment shall be made to the extent:

- .1 that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or
- .2 that an equitable adjustment is made or denied under another provision of this Contract.

14.3.3 Adjustments made in the cost of performance may have a mutually agreed fixed or percentage fee.

**Bid Package 1 - HVAC Renovations and Upgrades at BES, DES, NEES, VFMS, CHS & WVAB
for the Tredyffrin/Easttown School District**

**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.

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.

#26-016.01

SGC - 3

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.

Section 3.7.5 is added as follows:

#26-016.01

SGC - 4

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 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

#26-016.01

SGC - 5

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.

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:

#26-016.01

SGC - 6

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.

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. 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:

#26-016.01

SGC - 8

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 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

#26-016.01

SGC - 9

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. 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:

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:

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.

#26-016.01

SGC - 11

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

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 \$1,000,000
 - (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 \$4,000,000 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;
6. Building Collapse - in an amount sufficient to cover damages suffered by Owner and/or the general public, but no less than \$1,000,000;
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:

#26-016.01

SGC - 13

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 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.

#26-016.01

SGC - 14

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 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 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:

#26-016.01

SGC - 16

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 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:

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.

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:

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

#26-016.01

SGC - 19

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

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:

#26-016.01

SGC - 20

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

DIVISION 1 - GENERAL REQUIREMENTS

Index

Section 1 - SUMMARY OF THE WORK
Section 2 - CUTTING AND PATCHING
Section 3 - DEMOLITION
Section 4 - PERMITS, LICENSES AND CERTIFICATIONS
Section 5 - PROJECT MEETING
Section 6 - JOB SITE ADMINISTRATION
Section 7 - CONSTRUCTION SCHEDULE
Section 8 - CONSTRUCTION NOISE CONTROL
Section 9 - SHOP DRAWINGS, SAMPLES, & SPECIFICATIONS
Section 10 - INSPECTIONS & TESTING
Section 11 - LAYOUT DATA
Section 12 - PARKING
Section 13 - TEMPORARY ELECTRICITY
Section 14 - TEMPORARY HEAT
Section 15 - TEMPORARY WATER
Section 16 - TEMPORARY SANITARY FACILITIES
Section 17 - TEMPORARY TELEPHONE
Section 18 - PROJECT IDENTIFICATION
Section 19 - FENCES
Section 20 - TREE AND PLANT PROTECTION
Section 21 - PRODUCTS
Section 22 - STANDARDS OF QUALITY
Section 23 - CLEANING UP
Section 24 - STRUCTURAL DEFECTS
Section 25 - EXPOSED MEP COMPONENTS
Section 26 - RETAINAGE
Section 27 - TOUCH-UP AND REPAIR
Section 28 - ACT 287
Section 29 - PUMPING AND BAILING
Section 30 - WEATHER AND PROTECTION OF WORK
Section 31 - EQUAL OPPORTUNITY
Section 32 - PUBLIC WORKS EMPLOYMENT VERIFICATION ACT REQUIREMENTS
Section 33 - AS BUILT DRAWINGS AND CLOSE OUT BINDERS

Section 1 - SUMMARY OF THE WORK

- A. The work includes but is not limited to:

Bid Package 1 - HVAC Renovations and Upgrades at BES, DES, NEES, VFMS, CHS & WVAB for the Tredyffrin/Easttown School District

#26-016.01

GR - 2

C. The location of the projects are:

Beaumont Elementary School (BES)
575 Beaumont Road
Devon, PA 19333

Devon Elementary School (DES)
400 S. Fairfield Road
Devon, PA 19333

New Eagle Elementary School (NEES)
507 Pugh Road
Wayne, PA 19087

Valley Forge Middle School (VFMS)
105 W. Walker Road
Wayne, PA 19087

Conestoga High School (CHS)
200 Irish Road
Berwyn, PA 19312

West Valley Administration Building
940 West Valley Road, Suite 1700
Wayne, PA 19087

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 & 070151) 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. Any work, which extends past the Contract Completion Date, and is duly subject to liquidated damages, and coincides with the school session, shall be scheduled as approved by the owner. Additionally, it must conform to the regulations of Tredyffrin Township.

#26-016.01

GR - 3

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.
- 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

#26-016.01

GR - 4

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 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 is responsible for protection of existing conditions within their scope of work, unless otherwise identified on the drawings or specifications.
 - a. ***When temporary protection (for existing or new construction) is required for the scope of work or when dictated by owner or architect, contractor is required to provide (at a minimum) Masonite protection board with taped seams for floor protection, plywood boards for roof protection, and exhaust fans/filters with sealed air barriers at openings for protection of out of work scope areas from dust. All temporary protection shall be at no extra cost to the owner. Contractor is responsible for installation and removal of temporary protection.***

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.

#26-016.01

GR - 5

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 to each School. 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, 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 at 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 |
- 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

#26-016.01

GR - 6

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 **Mechanical 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, sub subcontractors, 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. Though not a part of the work schedule, the Contractors are advised that all work occurring on or after **August 18, 2027**, and subject to liquidated damages, shall be performed on Second Shift, 3:30pm to 11:00 pm at no additional cost to the Owner.
- F. Primes working overtime and shift work is at Prime Contractors expense and not additional cost to TESD; including work performed after substantial completion
- G. 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.
 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 01041 – Project Coordination Multiple Primes Contracts for additional information.

#26-016.01

GR - 7

- H. 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 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 01330 – Submittal Procedures of these Specifications.

Section 10 – INSPECTIONS & TESTING

- 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

#26-016.01

GR - 8

- 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.

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.
- 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.

#26-016.01

GR - 9

- 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. NOT USED

Section 16 - TEMPORARY SANITARY FACILITIES

- A. The Contractors will not be allowed to utilize the toilet facilities at the school. The Mechanical 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. No nameplates, signs, bills, advertising or displays will be allowed at the site under construction.

Section 19 - CONSTRUCTION FENCES

#26-016.01

GR - 10

- A. 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.

Section 20 - TREE AND PLANT PROTECTION

- A. No existing vegetation shall be cut, pruned, tied or removed unless and until the approval of the 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 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.

#26-016.01

GR - 11

- 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. If required, 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 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

- 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.

#26-016.01

GR - 12

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 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 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.

Section 31 - EQUAL OPPORTUNITY

#26-016.01

GR - 13

- 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 to obtain a copy of the Form.
- 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)**.

#26-016.01

GR - 14

- B. It will be necessary to produce "As-Built" drawings, at completion of the project, in order to receive final retainage monies. The necessary sets of base drawings will be furnished by the Owner to the contractor for **(1) one set** of such "As-Built" drawings.
- 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

#26-016.01

FofA - 1

FORM OF AGREEMENT

TREDYFFRIN/EASTTOWN SCHOOL DISTRICT AND CONTRACTOR

This agreement, made this _____ day of _____, 202__, between The Tredyffrin/Easttown School District, 940 West Valley Road, Suite 1700, Wayne, Pennsylvania 19087, and the "Contractor".

The Contractor is:

The Project is: Bid Package 1 - HVAC Renovations and Upgrades at BES, DES, NEES, VFMS, CHS & WVAB
for the Tredyffrin/Easttown School District

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 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 supercedes 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 **August 18, 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.

#26-016.01

FofA - 2

ARTICLE 4
CONTRACT SUM

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 \$

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 of the entire Work, a sum sufficient to increase the total payments to ninety-five percent (95%) of the Contract Sum, less such amounts as the Architect and the Owner shall determine for all incomplete Work and unsettled claims as provided in the Contract Documents. Reduction or limitation of retainage, if any, shall comply with Pennsylvania Statute 73 PS 1625.

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

#26-016.01

FofA - 3

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 September 23, 2026

1. **Specifications: Bid Package 1 - HVAC Renovations and Upgrades at BES, DES, NEES, VFMS, CHS & WVAB – Specifications**
2. **Drawings:** See Sheet **A001** for list of drawings.
2. **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

#26-016.01

BC - 1

BIDDERS CHECK LIST

Bidders should check to confirm that the following items are completed and are part of the 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

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.

#26-016.01

SECTION 01041 - 2

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.
- 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 Mechanical Construction shall provide a full-time Project Coordinator, experienced in administration and supervision of building construction, including mechanical, electrical 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.

- B. General/ Plumbing/Electrical Coordinators: The General Contractor, the plumbing contractor, and the Electrical contractor shall each provide a full-time general trades/plumbing/electrical coordinator, experienced in administrative and supervisory coordination of general trades, 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/general/plumbing/electrical construction with other types of operations.

1. The General/Plumbing/Electrical Coordinators shall be required to act as the specialized coordinator of construction activities within mechanical, general, plumbing, and electrical operations, and between those activities and activities of other separate prime contracts.
2. Construction activities requiring coordination by the General/Plumbing/Electrical Coordinator include but are not limited to:
 - a. Scheduling and sequencing of general, plumbing, and electrical activities.
 - b. Sharing access to work spaces.
 - c. Integration of general, plumbing, and electrical into limited spaces available for mechanical installations.
 - d. Protection of each prime Contractor's work.
 - e. Cutting and patching.
 - f. Tolerances.
 - g. Preparation of general,plumbing, and electrical coordination drawings.
 - h. Inspections and tests.
 - i. Utilization of mechanical and electrical temporary services and facilities.
 - j. Attendance at all construction meetings

#26-016.01

SECTION 01041 - 4

- 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. Provide and maintain temporary fire extinguishers throughout construction as required.
 - 10. Pest control
 - 11. Barricades, warning signs, and lights.
 - 12. Temporary enclosure for building exterior
 - 13. 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

#26-016.01

SECTION 01041 - 5

- 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 Section 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 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. Coordination with all Primes, Owner and Architect required.

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.

#26-016.01

SECTION 01041 - 6

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.
9. 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. Temporary enclosures for its own construction activities.
 4. Staging and scaffolding for its own construction activities.
 5. General hoisting facilities for its own construction activities.
 6. Waste disposal facilities, including collection and legal disposal of its own hazardous, dangerous, unsanitary, or other harmful waste materials.
 7. Progress cleaning of work areas affected by its operations on a daily basis.
 8. Secure lockup of its own tools, materials, and equipment.
 9. Construction aids and miscellaneous services and facilities necessary exclusively for its own construction activities

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

#26-016.01

SECTION 01041 - 7

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.
- 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.

#26-016.01

SECTION 01041 - 8

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.
 - 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

SECTION 01330 – 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.

- 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.

- 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., HES-022000.01). A second submittal for the same Specification Section would include the next sequential number (e.g., HES-022000.01 for grass seed mixture; HES-022000.02 for topsoil). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., HES-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., HES-022000.01 for grass seed mixture; HES-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.
 - 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.
 - 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

3.1 CONTRACTOR'S REVIEW

#26-016.01

01330 - 7

- 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

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.

#26-016.01

014000 - 2

- 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.

#26-016.01

014000 - 3

- 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.

#26-016.01

014000 - 4

- 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:

#26-016.01

014000 - 5

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect or Construction Manager Agent.
2. Notify Architect and Construction Manager Agent 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 and Construction Manager Agent'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

#26-016.01

014000 - 6

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.

#26-016.01

014000 - 7

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 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.

#26-016.01

017700 - 2

- 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.

#26-016.01

017700 - 3

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.
 3. Include the following information at the top of each page:

#26-016.01

017700 - 4

- 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.

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.
 - 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.

#26-016.01

017700 - 6

- 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 starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION

#26-016.01

024119 - 1

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.

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.

#26-016.01

024119 - 2

- C. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- D. Predemolition Photographs or Video: Submit before Work begins.
- E. 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 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.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

#26-016.01

024119 - 3

1.7 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 measured drawings preconstruction photographs preconstruction videotapes and templates.

#26-016.01

024119 - 4

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. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. Arrange to shut off indicated utilities with utility companies.
 - 3. 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.
 - 4. 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.

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:

#26-016.01

024119 - 5

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, 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.

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 designated by Owner.
5. Protect items from damage during transport and storage.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Doors: Where existing doors interface with new construction, leave existing doors in place until the latest possible time in the project, and after new construction is weather tight and does not produce odors and debris that would migrate through the existing doors, if removed.
- B. 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.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

#26-016.01

024119 - 6

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.
 - 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

#26-016.01

042000 - 1

SECTION 042000 – UNIT MASONRY

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. The extent of each type of masonry work is shown on the Drawings, and generally consists of patching. The unit masonry assemblies include, but are not limited to, the following:
 - 1. Concrete masonry units (CMU).
 - 2. Face brick.
 - 3. Mortar and grout.
 - 4. Reinforcing steel.
 - 5. Masonry joint reinforcement.
 - 6. Ties and anchors.
 - 7. Embedded flashing.
 - 8. Miscellaneous masonry accessories.
 - 9. All precast concrete lintels.
- B. Related Sections include the following:
 - 1. Division 7 Section "Sheet Metal Flashing & Trim" for exposed metal flashing.
 - 2. Division 7 Section "Joint Sealants" for sealing control and expansion joints in unit masonry.

1.3 TESTING AND INSPECTION

- 2. Testing and Inspection: The Owner will retain an agency to provide inspection and testing services. Contractor shall provide access to work areas as needed. Contractor shall coordinate masonry work requiring testing and inspection with Owner's testing and inspection agency and notify agency 24 hours before masonry work is scheduled to begin. Any costs borne to the testing agency related to the canceling of scheduled masonry work will be the responsibility of the Contractor. Supplemental tests required due to replacement of unsatisfactory masonry shall be at the Contractor's expense. Testing must comply with Chapter 17 of the IBC and ASTM C 1093.
- B. The testing agency shall inspect each aspect of masonry wall construction continuously whenever masonry work is in progress. Inspector shall inspect each of the following items:
 - 1. Placement of joint reinforcement and reinforcing bars.
 - 2. Grouting operations.
 - 3. Preparation of masonry unit, mortar and grout test specimens.

#26-016.01

042000 - 2

- C. Testing agency reports to be submitted within 24 hours, to the Owner, Contractor, Architect and Structural Engineer. Reports to define the area inspected/tested and results of the same.

1.4 CONCRETE MASONRY WALL CONSTRUCTION

- A. Masonry work is designed and detailed on the basis of conventional concrete masonry units.
- B. Conventional masonry units shall meet the following requirements:
 - 1. All cores line up.
 - 2. Vertical reinforcement, if required, are to be placed in the center of or off center of the cores and fully grouted as detailed on the Drawings.
 - 3. Horizontal reinforcement to be located in bond beam concrete masonry units with knockout webs, or in open-end "Ivany" type bond beam units, and fully grouted.
 - 4. Block faces shall not be out of alignment with an adjacent unit by more than 1/16", and 1/4" over 12'- 0".
 - 5. Cleaning must comply with BIA Technical Note No. 20 and NCMA TEK 8-2.

1.5 PERFORMANCE REQUIREMENTS

- A. Provide unit masonry that develops indicated net-area compressive strengths (f_m) at 28 days.
- B. Determine net-area compressive strength (f_m) 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.

1.6 SUBMITTALS

- A. The General Contractor shall review and approve, and then submit to the Architect for review the following:
 - 1. Manufacturer's specifications, instructions and other data as well as manufacturer's certification of specification compliance for each type of masonry unit, accessory and associated materials, cleaning solutions and methods.
 - 2. Samples of brick and each type of block, and specified accessories.
 - 3. Mix designs for each type of Mortar and Grout used. 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/C 91M for air content.
 - 4. Complete fabrication and placement shop drawings for bar reinforcement.
 - 5. Color samples are required for mortar selection. It is the intent for the new, exterior face brick to match the existing, adjacent brick. See also Item 1.8 for job mockup requirements.
 - 6. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing

#26-016.01

042000 - 3

bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show all reinforcement in elevation. (Submit 5 prints of each shop drawing, 1/8" = 1'-0" minimum scale).

- B. Pre-Construction Testing: Six weeks prior to delivery of masonry materials to the site, the Contractor shall perform the following pre-construction tests on proposed materials and submit results to the Owner, Architect and Engineer.
1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C140 for compressive strength.
 2. Mortar Test: For each mix required, according to ASTM C 780 for compressive strength.
 3. Grout Test: For each mix required, according to ASTM C 1019 for compressive strength.

1.7 QUALITY ASSURANCE

- A. Quality Control:
1. The Contractor shall plan and manage a program for controlling the quality of materials and workmanship to insure that the work conforms to the Contract Documents. As a minimum, this program shall consist of selection of suitable material sources, supervision of the construction process, performance of the specified testing and certification of conformance with the Contract Documents.
 2. The Contractor shall assign a member of said Contractor's organization to be responsible for administering the quality control program, to communicate with the Design Professionals regarding any questions, difficulties or proposed alternatives of materials or procedures and to prepare and sign a certificate stating that the completed masonry work meets the Contract Documents.
 3. The masonry must match the adjacent masonry in color, texture and craftsmanship.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate required.
- C. 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, through one source from a single manufacturer for each product required.
- D. Fire-Rated Masonry: Wherever a fire-resistance classification is shown or scheduled for unit masonry construction (4 hr., 3 hr., and similar designations), comply with the requirements for materials and installation established by governing authorities for the construction shown.

1.8 JOB MOCK-UP

- A. Prior to construction of masonry work, the Contractor shall erect a sample wall panel using materials, bond and joint tooling shown or specified for the final work. This panel shall show special features as directed for caulking, flashing, weep hole protection and contiguous work including cavity insulation, exterior gypsum and studs. At the archi-

#26-016.01

042000 - 4

tect's option a sample can be built as part of the construction, but will be removed, at the contractor's cost, if unacceptable to the architect.

- B. Panel shall be built at the site, where directed by the Architect, shall be of full thickness, approximately 4' x 6', and shall indicate the proposed range of color, texture, products, and workmanship for brickwork on one face and block work on the other face to be expected in the completed work. This must be done for each type of brick.
- C. The Architect's acceptance of visual qualities of the panel shall be obtained prior to continuance of masonry work. Pointing samples for joint color (mix or masonry materials) will not exceed three samples. The mortar to be used on the project will be in an approved sample wall panel. Panel will remain in place until the brick erection is complete.
- D. Contractor shall be responsible for the construction of two panels for each type of wall system and each type of face brick.

1.9 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 sheathing, 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 lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.10 PROJECT CONDITIONS

- A. No masonry work shall proceed in rain or snow or when temperatures fall below 25 degrees F, unless approved by the Architect.
- B. General Protection Requirements:
 - 1. The Contractor shall provide protection of the masonry units, cementitious materials and sand from rain, snow or ground water.
 - 2. Tops of masonry shall be covered at all times when work is not in progress. Protective covers shall be strong, waterproof, non-staining membrane, shall extend a minimum of 24 inches below tops of wall along both sides of wall, and shall be securely held in place.

#26-016.01

042000 - 5

3. All walls to be grouted shall be protected from rain or snow with full height waterproof protective covers along both sides of wall.
 4. When within 24 hours after grouting rain or snow is forecasted, all freshly grouted walls shall be completely covered (full height) with waterproof protective covers.
 5. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
- C. Do not apply uniform floor or roof loads for at least 48 hours and concentrated loads for at least 3 days after building masonry walls or columns.
- D. 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.
- E. Cold Weather Construction Requirements:
1. When air temperature falls below 40 degrees F, high-early-strength (Type III) Portland Cement shall be used in mortars and grouts.
 2. Grout shall be placed in masonry at a minimum temperature of 70 degrees F and maintained above 32 degrees F for 24 hours following placement of grout.
 3. When air temperature is 40 degrees F to 32 degrees F, sand **OR** mixing water must be heated to a minimum of 70 degrees F and a maximum of 160 degrees F.
 4. When air temperature is 32 degrees F to 25 degrees F, sand **AND** mixing water must be heated to a minimum of 70 degrees F and a maximum of 160 degrees F.
 5. Temperatures from 25-20 degrees F Heat mixing water, sand, mortar, grout materials between 40-120 deg. F. Heat masonry units to 40 deg. F. Heat both sides of the walls to maintain minimum 32 deg. F within the insulated enclosures.
 6. Tent and heat the work areas in an effort to maintain the construction schedule.
 7. Comply with BIA Technical Note No. 1 Revised-92: Cold Weather Masonry Construction - Introduction. There will be no additional cost for cold weather protection and erection.
 8. Cavity insulation and gypsum boards may not be exposed to weather more than two weeks without being covered with a weather protection barrier that is waterproof. This barrier must be maintained daily to prevent water intrusion and must run to the roof.
- F. Cold Weather Protection Requirements:
1. When the expected Low Night Temperature is forecasted between 25 degrees F and 20 degrees F, all fresh masonry work shall be completely covered, for the full height, with insulating blankets.
 2. When the expected Low Night Temperature is forecasted between 25 degrees F and 20 degrees F and also rain or snow is imminent, all fresh masonry work shall

#26-016.01

042000 - 6

- be completely covered, for the full height, with waterproof covers and insulating blankets and blankets secured against wind.
3. During cold weather, the temperature in the fresh masonry must be maintained above 32 degrees F for at least 24 hours after placement of masonry units **AND** at least 24 hours after grouting.
 4. Remove any ice or snow that may accumulate on any areas of the masonry in the process of construction. Heat may have to be applied to get the surface dry to the touch.
 5. Remove all masonry which has been damaged by freezing.
 6. No additives containing calcium chloride will be allowed; non corrosive accelerators such as "Accelguard 80" will be allowed when first approved by the Architect.
 7. The Contractor must make every effort to avoid delays due to weather. Tent and heat walls so that work can proceed in cold weather in order to maintain the schedule.
- G. The Masonry contractor shall direct the concrete contractor as to proper location of all dowels required from concrete to masonry.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portland Cement: ASTM C 150, Type I, except Type III shall be used for cold weather protection. Masonry cement or blended cement shall not be used.
- B. Hydrated Lime: ASTM C 107, Type S. (Type SA is not permitted).
- C. Quicklime: ASTM C 5. Thoroughly cool, slaking with cold water, before using in mortar.
- D. Sand: ASTM C 144. The color of the mortar will be partially dependent on the color of the sand. "Yellow" sand will not be acceptable. "Brown" or "Tan" sand to be utilized. Sample to be erected at site and the intent is to match existing.
- E. Pea Gravel: ASTM C 33.
- F. Aggregate for Grout: ASTM C 404.
- G. Water: Clean, clear, potable.
- H. Reinforcement and Galvanized Carbon Steel Wire: ASTM A 615, Grade 60 and ASTM A 641.
- I. Ties and Anchors: ASTM A 82 with ASTM A 153, Class B-2 coating.
- J. Embedded Flashing Materials: Asphalt coated copper flashing, 5 oz./ sq. ft. copper.
- K. Through-Wall Flashing: EPDM Manufactures standard flashing product formed from

#26-016.01

042000 - 7

a terpolymer of ethylene-propylene, complying with ASTM D 4637, 0.40 inch thick.

2.2 MASONRY UNITS

- A. Masonry units shall be manufactured in accordance with the specifications of ASTM C 90, with a minimum net-area compression strength (f_m) as indicated on the Drawings. Aggregate shall conform with ASTM C 33. Units shall be from one manufacturer and shall have uniform color and texture.
 - 1. Provide standard smooth face block with consistent finish, but on this project the intent is to match the existing brick.
 - 2. Provide special shapes as required for lintels, bond beams, etc.
 - 3. All masonry units shall be steam cured, a minimum of 28 days old at time of delivery and shall be completely and continuously protected from exposure to rain or other sources of moisture from time of casting until final placement in wall. All units to be dry, free from soil, ice and frost when laid in wall.
 - 4. Fire Ratings: Concrete masonry units within fire rated walls shall be fire rated classified units and be of the composition to conform to the required fire rating.
 - 5. Bull nose block to be used at all outside corners in the building interior.
 - 6. All precast concrete lintels shall have a minimum compressive strength of 3000 psi at 28 days and comply with the requirements for Cast-in-Place Concrete, including, but not limited to ACI 301 "Specifications for Structural Concrete in Buildings".
 - 7. Toothing the CMU will not be required for the infill as it will be covered. CMU is required to match the existing CMU it is infilling. Assume the CMU is 10" thick for this project.
- B. Face Brick: The intent is to match the existing brick and mortar. Infill brick will be toothed into existing brick.

2.3 MORTAR AND GROUT

- A. Mortar shall be Type S or as indicated on the Drawings for CMU in accordance with ASTM C 270. The use of admixtures is not permitted, except as specified for cold weather protection.
 - 1. Masonry cement or blended cement will not be permitted.
- B. Grout shall be in accordance with ASTM C 476, minimum strength as indicated on the Drawings.
 - 1. Use fine grout in grout spaces less than 4 inches in horizontal dimension, unless otherwise indicated.
 - 2. Use course grout in grout spaces 4 inches or more in least horizontal dimension, unless otherwise indicated.
- C. See also Item 1.8 above for mock up panel requirements.

2.4 MASONRY ACCESSORIES

#26-016.01 042000 - 8

- A. Wall ties: Not applicable. It is understood that there is no cavity.
- B. Bond breaker strips shall be 15 lb. asphalt roofing felt complying with ASTM D 226 or 15 lb., coal-tar roofing felt complying with ASTM D 227.
- C. Provide continuous galvanized joint reinforcing ASTM A 153 Class B-2 in all masonry walls, Hohmann & Barnard 130 Truss-Tri-Mesh. Standard weight (9 ga x 9 ga) Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated. Provide continuity at corners and wall intersections by using prefabricated "L" and "T" sections. Fabricated in conformance with ASCE/ACI 530 building code requirements and ASTM A 951.
- D. Control Joints in CMU walls to be made with sash block and "Blok-Tite AA 2000 as manufactured by AA Wire Products or an alternative of a quality necessary to meet the specifications. See sealant specifications. Division 7.
- E. Through-Wall Flashing: EPDM Manufactures standard flashing product formed from a terpolymer of ethylene-propylene, complying with ASTM D 4637, 0.40 inch thick. Extend through-wall flashing to within 1/8" of the exterior face of the brick, or the face of the wall finish but not visible. All sections of through wall flashing must overlap a minimum of 6 inches and shall be sealed so that the waterproof membrane is continuous in the wall cavity.
- F. Vertical Weeps shall be full height vertical joint, flashed weep holes must be clear to allow moisture to flow through. Cavity drainage material, 1" thick, reticulated, nonabsorbent polyethylene mesh placed behind weep holes, similar to Mortar Net. Weeps at base of wall, or above stone base, shall be 32" on center. Weeps to be located a minimum of 6" above finish grade.
- G. Rectangular Plastic Weep/Vent Tubing: Clear butyrate, 3/8 by 1-1/2 x 3-1/3 inches, at window heads. A minimum of three weeps per window head, not more than 24" on center. See Drawings for locations.

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 work.
 - 1. For the job record, prepare written report, endorsed by the Installer, listing conditions detrimental to performance of work.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

#26-016.01

042000 - 9

- A. Walls shall be constructed to the full thickness shown except single-wythe walls shall be built to the actual thickness of masonry units, using units or nominal thickness shown or specified.
- B. Except where noted otherwise on Drawings, CMU and brick shall be laid in running bond with vertical joint in each course centered on units in courses above and below. It shall be laid with completely filled bed and head joints and shaved into place. Head joints shall not be slushed. The new brick must be toothed where new units are adjoining existing brick.
- C. Walls shall be laid out in advance for accurate spacing of surface bond patterns, with uniform joint widths and to properly locate opening, movement-type joints, returns and offsets. Use of less than half-size units shall be avoided at corners, jambs and wherever possible at other locations.
- D. Walls shall be laid up plumb and true and with courses level, accurately spaced and coordinated with other work.
- E. Walls shall be laid with 3/8" joints (match existing). Width shall be maintained, except for minor variations required to maintain bond alignment. In no case will joints over 1/2 inch or under 1/4 inch be accepted. Joints shall be cut flush for walls which are to be concealed or to be covered by other materials. Joints shall be raked where necessary in preparation for application of caulking or sealants. Unless otherwise noted, other joints shall be tooled slightly concave.
- F. Loose steel lintels: Over openings greater than 1'- 0" where steel lintels are not specified, lintels shall be provided as scheduled and detailed on the Drawings. All steel lintels in exterior wall shall be hot dip galvanized, per ASTM A153.
- G. Provide bond beam lintels at locations in non-load bearing walls where lintels are not shown. See Drawing for schedule and additional requirements.
- H. Control joints shall be constructed in masonry where shown on the Drawings.
- I. Chases and recesses shall be provided as shown and as required for the work of other trades. Not less than 16" of masonry shall be provided between chase or recess and jamb of opening, and between adjacent chases and recesses.
- J. When stopping and resuming work, each course shall be racked back, not toothed 1/2 masonry unit length. Exposed surfaces of set masonry shall be cleaned and loose masonry units and mortar removed prior to laying fresh masonry.
- K. Masonry units disturbed after laying shall be removed, cleaned and relayed in fresh mortar. Corners shall not be hammered at jambs to fit stretcher units which have been set in position. If adjustments are required, units shall be removed, cleaned of mortar, and reset in fresh mortar.
- L. Masonry units shall be cut with a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges. Units shall be cut as required to provide pattern shown and to fit

#26-016.01

042000 - 10

adjoining work neatly. Full units shall be used without cutting wherever possible.

- M. Items specified under this and other Sections of these Specifications shall be built in as the work progresses. Spaces around built-in items shall be filled in solidly with masonry. Spaces between hollow metal frames and masonry shall be filled in solidly with mortar.
- N. Concrete masonry units shall not be wetted.
- O. Mortar ingredients shall be mixed for a minimum of 5 minutes in a mechanical batch mixer. Mortar may not be used if it has begun to set or if more than 2-1/2 hours have elapsed since initial mixing. Mortar shall be retempered during the 2-1/2 hour period as required to restore workability, provided that mortar strength is tested after retempering.
 - 1. The freezing point of mortar shall not be lowered by use of admixtures or anti-freeze agents.
 - 2. Calcium chloride shall not be used in mortar or grout.
 - 3. Frozen materials or materials mixed or coated with ice shall not be used. Comply with the BIA recommendations for brick masonry which is specified to be wetted. Masonry work damaged by frost or freezing shall be removed and replaced. Frozen work shall not be built upon.
- P. Grout for bond beams and filling of cores shall be proportioned using Portland cement, hydrated lime or lime putty, fine aggregate, and water per ASTM C 476. Grout lifts shall not exceed 60 inches. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.
- Q. All masonry joints shall be concave joints, densified with a joint tool at the correct time so that the mortar is not so wet that lines of wet mortar are drawn along the face of the joint.
- R. Fill all cores & joints of below-grade masonry. Fill cores with grout. Fill joints (e.g. shoulder joints) with mortar or grout.
- S. Provide supports, bar positioners and other devices for spacing and support of masonry reinforcing bars.

3.3 FIELD QUALITY CONTROL

- A. Testing: The Owner will retain an agency to provide inspection and testing services. Re-testing of materials failing to meet specified requirements shall be done at Contractor's expense.
- B. The testing agency shall inspect each aspect of masonry wall construction continuously whenever masonry work is in progress. Inspector shall inspect each of the following items:
 - 1. Placement of joint reinforcement and reinforcing bars.
 - 2. Grouting operations.
 - 3. Preparation of mortar and grout test specimens.
- C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

#26-016.01

042000 - 11

- D. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- E. Mortar Test: For each mix provided, according to ASTM C 780. Test mortar for compressive strength.
- F. Grout Test: For each mix provided, according to ASTM C 1019. Test grout for compressive strength.
- G. Testing agency reports to be submitted within 24 hours, one copy to the Owner, two copies to the Architect, and one copy to the Structural Engineer. Reports to define the area inspected/tested and results of the same.

3.4 REPAIR, POINTING AND CLEANING

- A. Masonry units which are loose, chipped, broken, stained or otherwise damaged, or units which do not match adjoining units as intended, shall be removed and replaced. New units to match adjoining units shall be provided and installed in fresh mortar or grout and pointed to eliminate evidence of replacement.
- B. During the tooling of joints, any voids or holes, except weep holes, shall be enlarged and completely filled with mortar. All joints at corners, openings and adjacent work shall be pointed to provide a neat, uniform appearance, properly prepared for application of caulking or sealant compounds.
 - 1. Exposed CMU masonry shall be cleaned by dry brushing at the end of each day's work and after final pointing to remove mortar spots, droppings, and smears.
- C. Exposed brick masonry surfaces shall be cleaned as recommended by BIA Technical Notes 20 "Cleaning Clay Products Masonry".
 - 1. The masonry contractor shall be responsible for protecting adjacent materials when cleaning brick walls. This protection shall include windows.
 - 2. Protection shall be accomplished by covering the area to be protected with 4 mil polyethylene, taped at the exposed perimeter to give total protection from direct wetting or spray.

3.5 TEMPORARY BRACING

- A. All masonry walls shall be adequately braced to resist all lateral loads such as wind and unbalanced fill. Bracing shall remain until walls are sufficiently strong and permanent bracing is installed and functional. Comply with OSHA and other safety regulations.

3.6 ON GOING WORK AREA CLEANING

- A. The General Contractor must clean floor and slab surfaces weekly. Remove sand, mortar, masonry units, dust and masonry supplies. If this is not done, the Owner will have this done at the Contractor's expense.
- B. The General Contractor must immediately clean masonry spills on adjacent surfaces

#26-016.01

042000 - 12

and/or materials to avoid damage. Any new or existing materials damaged due to lack of this kind attention by the General Contractor shall be replaced with new materials to match the existing damaged materials at no cost to the Owner.

END OF SECTION

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood blocking, and nailers.
2. Plywood backing panels and other applications as indicated on Drawings.

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

#26-016.01

061053 - 2

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.

1. Borate Preservative: Water-borne borate oxide (SBX) preservative.

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 cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood blocking, and similar concealed members in direct contact with masonry or concrete.
3. Wood construction as specified in other sections.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet 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.

#26-016.01

061053 - 3

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 interior 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. Power-Driven Fasteners: NES NER-272.

#26-016.01

061053 - 4

C. Screws for Fastening to Metal Framing:

1. Cold-Formed Metal Framing: ASTM C 954.
2. Other Metal Framing: ASTM C 1002.

D. Lag Bolts: ASME B18.2.1.

E. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

F. 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.

2.7 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.

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.

#26-016.01

061053 - 5

- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

END OF SECTION

#26-016.01

070151 - 1

SECTION 070151 - ROOFING REPAIRING

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. The extent of the roofing is shown on the Drawings.
- B. The work includes:
 - 1. Repair of roofing where rooftop equipment and/or penetrations are added or removed.
- C. The following types of roofing and roofing materials are specified in this section:
 - 1. Adhered membrane roofing system.
 - 2. Roof insulation. The Contractor shall supply and install all Roof Insulation required by the Specifications and Drawings.
- D. Related work specified elsewhere:
 - 1. Rough carpentry is specified in Section 061053.
 - 2. Mechanical components, including, but not limited to curbs, rails, pockets, etc. are specified in related Mechanical Drawings and Specifications.

1.3 DEFINITIONS (where standards listed below have been updated, the most current standard shall apply)

- A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.
- B. Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems," before multiplication by a safety factor.
- C. Factored Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems," before multiplication by a safety factor.

#26-016.01

070151 - 2

1.4 PERFORMANCE REQUIREMENTS (where standards listed below have been updated, the most current standard shall apply)

- A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.
- C. Roofing System Design: Provide a membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE 7.
 - 1. Wind uplift coverage of 65 miles per hour peak gust wind speed.
 - 2. Resist the factored design uplift pressures calculated according SPRI's "Wing Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems."
- D. FMG Listing: Provide roofing membrane, base flashings, and component materials that comply with requirements in FMG 4450 and FMG 4470 as part of a membrane roofing system and that are listed in FMG's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.
- E. Roofing System Design: Provide a membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist the factored design uplift pressures calculated according SPRI's "Wing Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems."

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For roofing system include plans, sections, details, and attachments to other work.
 - 1. Base flashings and membrane terminations.
 - 2. Tapered insulation, including slopes, for equipment crickets (if applicable).
 - 3. Insulation fastening patterns (if applicable).
- C. Samples for Verification: For the following products:
 - 1. 12 x 12 inch square of sheet roofing, including T-shaped side and end lap seam. Color to existing surrounding roof that remains.
 - 2. 12 x 12 inch square of roof insulation.
 - 3. 12 inch length of metal termination bars.
 - 4. Insulation fastener of each type, length, and finish.

#26-016.01

070151 - 3

- D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.
- E. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 - 1. Submit evidence of meeting performance requirements.
- F. Qualification Data: For Installer and manufacturer.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of roofing system.
- H. Research/Evaluation Reports: For components of membrane roofing system.
- I. Warranties:
 - 1. Existing Roofing. The existing roofs are currently under warranty. It is the intent of this specification that the modifications to these roofs do not void that warranty. Contractor shall show evidence by written notice from the roofing manufacturer that the new work has not compromised the warranty of the existing roof and that the new work retains the same warranty as the surrounding roof.
 - 2. Additional information about the existing roof and the existing warranty is contained in these specifications.
- J. Inspection Report: Provide a copy of all roofing system manufacturer's inspection reports, both in progress and of completed roofing installation, as soon as the contractor receives them.
 - 1. At the end of the work, furnish written confirmation from the roofing manufacturer(s) that the completed work is acceptable and that all existing warranties remain "in-force".
 - 2. At the end of the work, furnish warranty documentation from the roofing manufacturer as part of the Operations & Maintenance Manual.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty.
- B. Manufacturer's Qualifications: A qualified manufacturer that has UL listing, and FMG approval for membrane roofing system identical to that used for this Project.
- C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- D. Source Limitations: Obtain components for membrane roofing system from same manufacturer as roofing membrane.

#26-016.01

070151 - 4

- E. Fire-Test-Response Characteristics: Provide membrane roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriated markings and applicable testing and inspecting agency.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its shared shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protection during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instruction and warranty requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraphs titles below introduce lists, the following requirements apply for product selection, or alternatives of a quality necessary to meet the specifications:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
 - 2. Products: Subject to compliance with requirements, provide one of the products specified.

#26-016.01

070151 - 5

3. Available Manufacturer's: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturer's specified.
4. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
5. Single Source: Products must be provided from one manufacturer.

2.2 EPDM ROOFING MEMBRANE

- A. New EPDM Roofing Membrane: ASTM D 4637, Type II internally reinforced uniform, flexible sheet made from EPDM and as follows:
 1. Manufacturers
 - a. Elevate Roofing Systems (Firestone), fully adhered RubberGard. Warranty of existing roof must be maintained.
 - b. Carlisle SynTec Inc. Note that connection must be made between the existing Carlisle roof and the new roof. Warranty of existing roof must be maintained.
 2. Thickness .060 Fire Rated
 3. Exposed face color: Black

2.3 AUXILIARY MATERIALS

- A. General: auxiliary material recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
 1. Liquid type auxiliary materials shall meet VOC limits of authorities having jurisdiction.
- B. Sheet flashing: 60 mil thick EPDM partially cured according to application.
- C. Expansion joint shall be as shown on drawings and must meet or exceed the standards established by the Manufacturer's System.
- D. Bonding adhesive: Manufacturer's standard bonding adhesive.
- E. Seaming Material: Single component butyl splicing adhesive and splicing cleaner, or manufacturers standard synthetic rubber polymer primer and 7 inch wide minimum, butyl splice tape with release film as allowed by the membrane manufacturer. An in-line seam sealant on all seams.
- F. Lap sealant: Manufacturers standard single component sealant, black.
- G. Water cut off mastic: Manufactures standard butyl mastic sealant.
- H. Metal Termination Bars: Manufacturers standard predrilled stainless steel or aluminum bars, approximately 1 inch by 1/8 inch thick, with anchors.

#26-016.01

070151 - 6

- I. Metal Battens: Manufacturers standard aluminum zinc alloy coated or zinc coated steel sheet, approximately 1 inch wide by 0.05 inch thick pre-punctured.
- J. Fasteners: Factory coated steel fasteners and metal or plastic plates meeting corrosion resistance provisions in FMG 4470, designed for fastening membrane to substrate and acceptable to membrane roofing system manufacturer.
- K. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashing, preformed inside and outside corner sheet flashings, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

2.4 ROOF DECK INSULATION SYSTEM

- A. New Roof General: Provide a mechanically fastened rigid insulation roof deck system as provided and warranted by the membrane manufacturer, or alternative of a quality necessary to meet the specifications, for use over non-vented decks. Furnish all labor, materials, equipment and supervision for installing the complete roof deck system excluding the metal decking. Installation to meet Factory Mutual I-90 rating for uplift.
- B. Rigid Sloped Insulation System:
 - 1. Base layer insulation system: flat insulation, sloped by roof structure of closed cell polyisocyanurate foam core skinned on both sides with factory-applied facers of the generic type recommended by the membrane manufacturer. FS HH-1-1972, Class 2, UL Classified and Factory Mutual approved.
 - a. Starting thickness at low points (drain sumps) 4" minimum.
 - b. Minimum R-value of 7.14 per inch of thickness.
 - c. Flat isocyanurate fill shall start at 5" of thickness.
 - 2. Tapered insulation crickets between drain locations: 1/2" pitch per foot factory tapered and mitered closed cell isocyanurate foam core skinned on both sides with factory applied facers of the generic type recommended by the membrane manufacturer. FS HH-1-1972, Class 2, UL Classified and Factor Mutual approved.
 - 3. Top layer insulation: High density fiberboard insulation, ASTM C208, UL Classified.
 - a. Nominal thickness 1/2".
 - b. Minimum aged R-value 1.3.
- C. For Mechanical Equipment Crickets: At new rooftop mechanical equipment, curbs, pockets or other obstructions to the flow of rainwater, provide new crickets of tapered rigid insulation to shed water around unit and reestablish water flow to drain. Provide a mechanically fastened rigid insulation system as provided and warranted by the membrane manufacturer, or alternative of a quality necessary to meet the specifications, for use over non-vented decks. Furnish all labor, materials, equipment and supervision for installing the complete roof deck system excluding the metal decking. Installation to meet Factory Mutual I-90 rating for uplift.
- D. Approval of insulation is contingent upon approval by the membrane manufacturer for use with the specified roof system, and as component to maintaining the existing roofing warranty.

#26-016.01

070151 - 7

2.5 INSULATION FASTENERS

- A. Concrete Decks: Factory Mutual approved, high grade carbon steel spike with pan head and 3" round steel stress plates.
 - 1. Spiked and plates as approved by the membrane manufacturer.
- B. Fasteners for securing insulation to metal deck areas:
 - 1. #14 screw fasteners with 3" diameter plates. Provide fasteners and plates to meet FM 1-90 requirements. Fasteners and plates shall be coated with Taft-Coat Abrasion and Corrosion Resistance Coating.

PART 3 - EXECUTION

3.1 INSPECTION OF SUBSTRATE

- A. Examine substrate surfaces to receive insulation and roofing systems and associated work, and conditions under which systems will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer and Manufacturer.
 - 1. Verify proper fabrication, placement, and anchorage of metal edge angles, wood nailers and curbs.
 - 2. Contractor is advised to photograph areas of work, such that a visual pre-work record is created. Compose photos for clarity and for the purpose intended.
- B. MEETINGS: A pre-job conference including the Architect, Owner, Roofing Contractor and manufacturer's representative shall be conducted prior to application of roofing.
- C. FOREMAN: The roofing foreman shall have a copy of these specifications on the job site at all times. The presence of specifications and an inspector shall not relieve the Contractor of strict compliance with the manufacturer's specifications, detail drawings, and/or approved material requirements.
- D. DECK PENETRATIONS: Contractor shall verify that work penetrating the roof deck, or which may otherwise affect the roofing application, has been properly completed.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Insurance/Code Compliance: Install insulation and roofing systems for compliance with governing regulations and with Factory Mutual requirements for "Class I", including zoned wind resistance as specified by FM.
- B. Protect work from spillage of materials, and prevent materials from entering or clogging drains and conductors. Replace/restore other work damaged by installation of roofing and insulation.
- C. Verify flatness of roof for tapered insulation.

#26-016.01

070151 - 8

3.3 INSTALLATION OF RIGID INSULATION

- A. New Roof: Fasteners should be placed as recommended by system manufacturer. Insulation to be installed in a workmanlike manner. A minimum of fasteners as required by the insulation manufacturer for the type of deck and to meet the uplift requirements. Fasteners are to be installed in accordance with FMG's "Approval Guide".
- B. Mechanically Fastened Installation: Fasteners shall be installed to secure all flat and tapered insulation (fiberboard over flat or tapered polyisocyanurate) throughout the entire field of all metal and concrete deck roof areas.
- C. Fasteners shall be installed at the rate to meet Factory Mutual I-90 requirements and shall be of the length recommended by the manufacturer to securely fasten all layers of insulation.
- D. Provide additional fasteners as required by the manufacturer to obtain extended wind uplift coverage of 65 miles per hour peak wind gust speed.

3.4 PREPARATION OF SUBSTRATE TO RECEIVE ROOFING

- A. Roof Deck Insulation System: System must be surface dry and reasonably smooth prior to roofing. The roof deck insulation system installed in any given day must be roofed that same day.
- B. Clean the substrate of projections and substances detrimental to the work.
- C. Install fastening strips and similar accessories as shown, and as recommended by the prime materials manufacturer.
- D. Coordinate roofing with flashing and other adjoining work to ensure proper sequencing of the entire work.

3.5 GENERAL WORKMANSHIP

- A. Substrate: Free of foreign particle prior to laying roof membrane.
- B. Phased application: Not permitted. All membrane placed each day shall be fully adhered to new insulation substrate by the end of each work day.
- C. Traffic and Equipment: Kept off completed membrane at all times. In the event traffic is unavoidable, protect membrane with 1/2" thick plywood sheets with rounded corners.
- D. Wrapper and packaging materials: Not to be included in roofing system.
- E. Entrapped debris: Not permitted beneath new membrane. Its discovery is sufficient cause for rejection.
- F. Fit membrane into roof drain rims; set membrane in water cut-off mastic; secure clamping collars; install domes.

#26-016.01

070151 - 9

- G. Extend roofing membrane over top perimeter edge, walls and projection bases as required by manufacturer and roof edge manufacturer.
- H. Mechanical fasteners:
 - 1. Seated firmly in discs with fastener heads flush or below disc's top surface.
 - 2. Length: Sufficient to accommodate roof insulation thickness and engage metal deck 1/2 inch (13 mm) and concrete deck 1-1/2".
- I. Insulation:
 - 1. Install insulation boards in courses parallel to roof edges adhering surface up.
 - a. Firmly butt each insulation board to surrounding boards. Do not jam or deform boards.
 - b. Eliminate open joints and uneven surfaces.
 - 2. Maximum insulation gap: 1/4" inch (6 mm).
 - 3. Fill insulation board joint gaps larger than 1/4 inch (6 mm) with roof insulation.
 - 4. Maximum elevation variation between boards at joints: (1/8 inch (3 mm)).
 - 5. Cut and fit insulation boards where roof deck intersects vertical surfaces. Cut board 1/4 inch (6 mm) from vertical surface.
 - 6. Stagger joints at least 6 inches (150 mm).
 - 7. Filler size: 18 inches (460 mm) in length or width, minimum.
- J. Insulation: Form continuous insulation joints over deck flange. Do not cantilever insulation edges over deck ribs. Minimum bearing surface: 1-1/2 inches (38 mm).

3.6 PREPARATION

- A. Protection:
 - 1. Contractor shall be responsible for protection of property during the course of work. Lawns, shrubbery, paved areas, and building shall be protected from damage. Repair damage at no extra cost to Owner.
 - 2. Roofing, flashings, membrane repairs, and insulation shall be installed and sealed in a watertight manner on same day of installation or before arrival of inclement weather.
 - 3. At start of each work day drains within daily work area shall be plugged. Plugs to be removed at end of each work day or before arrival of inclement weather.
 - 4. Preparation work shall be limited to those areas that can be covered with installed roofing material on same day and before arrival of inclement weather.
 - 5. Protect building surfaces at set-up areas with tarpaulin. Secure tarpaulin. Remove dumpster from premises when full and empty at approved dumping or refuse areas. Deliver empty dumpster to site for their use. Upon job completion, dumpster shall be removed from premises. Spilled or scattered debris shall be cleaned up immediately. Remove material to be disposed from roof as it accumulates.
 - 6. At end of each working day, removal areas shall be sealed with water stops along edges to prevent water entry.

#26-016.01

070151 - 10

- B. Surface Preparation: All surfaces shall be swept or vacuumed, removing all loose aggregate and foreign substances prior to commencement of roofing.
- C. Verify conditions as satisfactory to receive work.

3.7 CARPENTRY (Also Comply With Division 6, Rough Carpentry)

- A. Roof Edge:
 - 1. Mechanically attach wood blocking. Offset blocking layers 12 inches (300 mm); weave corners.
 - a. Blocking thickness: Equal to final insulation thickness including tapered edge strips. See drawings for construction details.
 - 2. Fasteners shall be installed in two (2) rows staggered. Spacing in any one (1) row shall not exceed 24 inches (610 mm). Within 8 feet (2.4 meter) of outside corners, spacing shall not exceed 12 inches (33 mm) in any one (1) row. Use non-corrosive anchors.

3.8 THERMAL INSULATION

- A. Mechanically attach multiple insulation layers to deck: Fastener density: One every 2 sq. ft. (one every 0.19 sq. meter).
 - 1. Install additional fasteners to ensure insulation is firm under foot.
 - 2. Drive mechanical fasteners flush to top surface.
 - 3. Filler insulation requires 2 fasteners per piece minimum.
- B. Provide additional fasteners as required by membrane manufacturer for extended wind uplift coverage of 65 miles per hour peak gust wind speed.

3.9 CRICKETS

- A. The intent is to direct all of the water to the drains.
- B. Crickets shall be placed directly over the flat base layer or tapered base layer of polyisocyanurate insulation. Crickets shall be overlaid with 1/2" thick high density fiberboard insulation to receive mechanical fasteners.
 - 1. Unless specifically shown otherwise, provide crickets at items mounted to, or penetrating the roof, to direct water around such obstructions, and toward the drains.

3.10 ROOF MEMBRANE INSTALLATION

- A. Membrane Applications: Apply roofing in accordance with roofing system manufacturer's instructions and the following requirements. Application of roofing shall immediately follow application of insulation as a continuous operation.

#26-016.01

070151 - 11

- B. Aesthetic Considerations. Make necessary preparations, utilize recommended application techniques, apply the specified materials and exercise care in ensuring that the finished application is acceptable to the Owner.
- C. Priming: Prime metal flange (all jacks, edge metal, drain flashings, etc.) and concrete and masonry surfaces with a uniform coating of primer.
- D. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer; 7" for 20 year warranty. Stagger end laps.
- E. Bonding adhesive: Apply bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allowed to partially dry before installing roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.
- F. Mechanically or adhesively fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.
- G. Apply roofing membrane with side laps shingled with slope of roof deck where possible.
- H. Adhesive Seam Installation: Clean both faces of splice areas, applying splicing cement, and firmly roll side and end laps of overlapping roofing membranes according to manufacturer's written instructions to ensure a water tight installation. Apply lap sealant and seal exposed edges of roofing membrane terminations.
 - 1. Apply continuous bead of in-seam sealant before closing splice if required by membrane roofing system manufacturer.
- I. Tape Seal Installations: Clean and prime both faces of splice areas, apply splice tape, and firmly roll end and side laps of overlapping roofing membranes according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing membrane terminations.
- J. Repair tears, voids, and lapping seams in roofing that does not meet requirements.
- K. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.

3.11 BASE FLASHING INSTALLATION:

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allowed to partially dry before installing roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.
- C. Flash penetrations and field formed inside and outside corners with cured or uncured sheet flashing.

#26-016.01

070151 - 12

- D. Clean splice areas, applying splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight installation. Apply lap sealant and seal exposed edges of roofing membrane terminations.

3.12 ADJUSTING AND CLEANING

- A. Repair of Deficiencies: Installations of details noted as deficient during final inspection must be repaired and corrected by applicator, and made ready for re-inspection within five (5) working days.
- B. Cleanup:
 - 1. Immediately upon job completion, roof membrane and flashing surfaces shall be cleaned of debris.
 - 2. Clean gutters, downspouts, roof drains and surrounding site of debris related to roofing construction.

3.13 DAILY WATERSTOP/TIE-INS

- A. Entire areas of roof are to be made watertight each day in accordance with the roof manufacturer and NRCA Guidelines.

3.14 PROTECTION

- A. The installer shall advise the Contractor in writing of recommended protection for the roofing during the remaining construction period, so that the work will be without damage or deterioration (except for normal weathering) at the time of acceptance.

3.15 FIELD QUALITY CONTROL

- A. Site Conditions: Following the completion of the job, ensure that all areas around job site are free of debris, roofing materials, equipment, and related items.
- B. Notification of Completion: Notify the manufacturer by means of manufacturer's printed
- C. Notification of Completion form of job completion in order to schedule a final inspection date.
 - 1. Submit final inspection report, and acknowledgement by the Manufacturer that work performed is satisfactory, is complete, and that the existing system warranty will remain in effect.

END OF SECTION

SECTION 072100 - THERMAL INSULATION

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. The extent of sound attenuating insulation work is shown on the Drawings, by the generic name or by its abbreviation.
- B. The applications of insulation specified in this Section include but are not limited to the following:
 - 1. Foam-plastic board insulation.
- C. Section includes Vapor Barriers
- D. Roof Insulation is specified in Division 00151 Roofing Repairing and is for patching.

1.3 QUALITY ASSURANCE

- A. Thermal Conductivity: The thicknesses shown are for the thermal conductivity (k-value at 75 degrees F) specified for each material. Provide adjusted thicknesses as directed for the equivalent use of material having a different thermal conductivity.
- B. Fire and Insurance Ratings: Comply with the fire-resistance, flammability and insurance ratings indicated, and comply with governing regulations as interpreted by authorities.

1.4 SUBMITTALS

- A. Manufacturer's Data, Thermal Insulation: Submit manufacturer's specifications and installation instructions for each type of insulation required. Include data substantiating that materials comply with specified requirements. Product limitations must be made clear in the manufacturer's submissions.

1.5 PRODUCT HANDLING

- A. Protection from Deterioration:

#26-016.01

072100 - 2

1. Do not allow insulation materials to become wet, soiled, or covered with ice or snow.
 2. Protect plastic insulation from exposure to sunlight.
- B. Fire Hazard: Do not deliver plastic insulating materials to the project site ahead of installation time. Protect at all times against ignition. Complete installation and concealment of plastic materials as rapidly as possible in each area of work.
- C. Do not overload the building structure with the storage of materials or use of installation equipment on the deck.

1.6 JOB CONDITIONS

- A. Examination of Substrate: The Installer must examine the substrate and the conditions under which the insulation work is to be performed, and notify the Contractor in writing of unsatisfactory conditions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. FOAM-PLASTIC BOARD INSULATION

1. 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.
2. Manufacturers: Subject to compliance with requirements,;
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Kingspan; GreenGuard Insulation Board.
 - d. Owens Corning.
3. Type IV, 25 psi.

B. VAPOR BARRIERS

1. 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.
2. 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.

#26-016.01

072100 - 3

3. Water-Vapor Permeance: Not less than 75 perms per ASTM E 96/E 96M, Desiccant Method (Procedure A).
4. Air Permeance: Not more than 0.004 cfm/sq. ft. at 0.3-inch wg when tested according to ASTM E 2178.
5. Allowable UV Exposure Time: Not less than three months.
6. Accessories: Vapor barrier tape, pressure sensitive, of type recommended by vapor barrier manufacturer for sealing joints and penetrations in vapor barrier.

C. MISCELLANEOUS MATERIALS:

1. Adhesive or Tape for Bonding Insulation: The type recommended by the insulation manufacturer, and complying with fire-resistance requirements.
2. Mastic Sealer: Type recommended by insulation manufacturer for bonding edge joints between units and filling voids in the work.
3. Mechanical Anchors: Type and size shown, or if not shown, as recommended by the insulation manufacturer for the type of application shown and condition of substrate.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's instructions for the particular conditions of installation in each case.
- B. General Building Insulation
 1. Apply insulation units to the substrate by the method indicated, complying with the manufacturer's recommendation.

3.2 PROTECTION

- A. Protect insulation work from exposure to moisture, damage and deterioration. Remove and replace insulation work which has become wet, damaged or deteriorated before proceeding with other work.
- B. Protect insulation work from exposure to moisture, damage, and deterioration, primarily by prompt installation of roofing or water-proofing work shown to be placed over the insulation. Remove and replace insulation work which has become wet, damaged or deteriorated before proceeding with other work.

END OF SECTION

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manufactured through-wall flashing with counterflashing.
2. Manufactured reglets with counterflashing.
3. Formed roof-drainage sheet metal fabrications.
4. Formed low-slope roof sheet metal fabrications.
5. Formed wall sheet metal fabrications.
6. 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. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
 3. Review requirements for insurance and certificates if applicable.
 4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.4 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.

#26-016.01 076200 - 2

2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
10. Include details of special conditions.
11. Include details of connections to adjoining work.
12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

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, Fascia, Copings, 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.
4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested.
- C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- D. 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.

#26-016.01

076200 - 3

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. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Build mockup of typical roof edge, including fascia trim, approximately 10 feet long, including supporting construction cleats, seams, attachments, underlayment, and accessories.
 - 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 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.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.9 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

#26-016.01

076200 - 4

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:
 - 1. Design Pressure: As indicated on Drawings.
- D. 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. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
 - 1. Exposed Coil-Coated Finish:
 - a. Mica Fluoropolymer: AAMA 620. Two-coat fluoropolymer finish with suspended mica flakes 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.
 - 2. Color: Refer to Finish Schedule on Drawings for color references.
 - 3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed; with smooth, flat surface.

#26-016.01

076200 - 5

1. Finish: 2B (bright, cold rolled).

2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F; and complying with physical requirements of ASTM D 226/D 226M for Type I and Type II felts.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Atlas Roofing Corporation; Summit.
- b. Engineered Coated Products; Nova-Seal II.
- c. Kirsch Building Products, LLC; Sharkskin Ultra.
- d. SDP Advanced Polymer Products Inc; Palisade.

- C. 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. Products: Subject to compliance with requirements, provide one of the following:

- a. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
- b. Grace Construction Products, a unit of W. R. Grace & Co.-Conn.; Grace Ice and Water Shield HT.
- c. Henry Company; Blueskin PE200 HT.
- d. Kirsch Building Products, LLC; Sharkskin Ultra SA.
- e. Metal-Fab Manufacturing, LLC; MetShield.
- f. Owens Corning; WeatherLock Specialty Tile & Metal Underlayment.
- g. Polyguard Products, Inc.; Deck Guard HT.
- h. Protecto Wrap Company; Protecto Jiffy Seal Ice & Water Guard HT.
- i. SDP Advanced Polymer Products Inc; Palisade SA-HT.

2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.

- D. 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.

#26-016.01

076200 - 6

- 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 Aluminum Sheet: Aluminum or Series 300 stainless steel.
 - 3. 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 or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.

2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cheney Flashing Company.
 - b. Fry Reglet Corporation.
 - c. Heckmann Building Products, Inc.
 - d. Hickman, W. P. Company.

#26-016.01

076200 - 7

- e. Hohmann & Barnard, Inc.
- f. Sandell Manufacturing.
- 2. Material: Stainless steel, 0.019 inch thick.
- 3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
- 4. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
- 5. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
- 6. Accessories:
 - a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
 - b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.
- 7. Finish: Mill.

2.6 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 - 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 2. Obtain field measurements for accurate fit before shop fabrication.
 - 3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 - 4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."
- D. 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.

#26-016.01

076200 - 8

- E. 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.
- F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- G. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- H. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- I. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.
- J. Do not use graphite pencils to mark metal surfaces.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Copings: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, fasten and seal watertight. Shop fabricate interior and exterior corners.
 - 1. Coping Profile: As indicated on Drawings.
 - 2. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
 - 3. Fabricate from the Following Materials:
 - a. Aluminum: 0.050 inch thick.
- B. Transitions Between Roof and Other Assemblies: Fabricate from the following materials: Shop fabricate interior and exterior corners.
 - 1. Aluminum: 0.050 inch thick.
- C. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
 - 1. Stainless Steel: 0.019 inch thick.
- D. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
 - 1. Stainless Steel: 0.019 inch thick.
- E. Flashing Receivers: Fabricate from the following materials:
 - 1. Stainless Steel: 0.016 inch thick.

#26-016.01

076200 - 9

F. Roof-Penetration Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.019 inch thick.

G. Roof-Drain Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.016 inch thick.

2.8 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. Aluminum: 0.032 inch thick.
2. Stainless Steel: 0.016 inch thick.

2.9 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.019 inch thick.

2.10 ACCESSORIES

A. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3000 psi at 28 days, with minimum 5 percent air entrainment.

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.

#26-016.01 076200 - 10

3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, according to manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.
- C. 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.
- D. 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.
 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.
 6. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

#26-016.01

076200 - 11

1. Coat concealed side of uncoated-aluminum and 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 solder metallic-coated steel and aluminum sheet.
 2. Do not pre-tin zinc-tin alloy-coated stainless steel and zinc-tin alloy-coated copper.
 3. Do not use torches for soldering.
 4. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 5. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
- H. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

#26-016.01

076200 - 12

3.4 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.
 - 1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch centers.
 - 2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.
- D. Copings: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.
- E. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
- F. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints minimum of 4 inches. Secure in waterproof manner by means indicated on Drawings.
- G. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with butyl sealant and clamp flashing to pipes that penetrate roof.

3.5 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

#26-016.01

076200 - 13

3.6 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.
- 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.

3.7 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.
- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.8 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

#26-016.01

SECTION 078413 - 1

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.

#26-016.01

SECTION 078413 - 2

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.
 - 8. Passive Fire Protection Partners.
 - 9. RectorSeal.
 - 10. Specified Technologies, Inc.
 - 11. STC Sound Control.
 - 12. Tremco, Inc.

#26-016.01

SECTION 078413 - 3

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.

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.

#26-016.01

SECTION 078413 - 4

- 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.

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.

#26-016.01

SECTION 078413 - 5

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.
 - 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.

#26-016.01

SECTION 078413 - 6

- 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

#26-016.01

079200 - 1

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. Butyl joint sealants.
6. Latex joint sealants.
7. Spray foam sealants.

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.

#26-016.01

079200 - 2

- C. 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.
- D. Field-Adhesion-Test Reports: For each sealant application tested.
- E. 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.
- C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

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. 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.

#26-016.01

079200 - 3

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: 20 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.

#26-016.01

079200 - 4

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; 791.
 - 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.
 - 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. Locations: Joints adjacent to masonry or that may drain onto masonry.

#26-016.01

079200 - 5

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 330 or 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. Locations: Interior bathrooms and other wet locations.

2.6 BUTYL JOINT SEALANTS

- A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Bostik, Inc.; Chem-Calk 300.
 - b. Pecora Corporation; BC-158.
 - c. Tremco; Tremco Butyl Sealant.

2.7 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:

#26-016.01

079200 - 6

- a. BASF Construction Chemicals, LLC, Building Systems; Sonolac.
- 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. Locations: Interior joints.

2.8 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.

2.9 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 B (bicellular material with a surface skin) , 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.

#26-016.01

079200 - 7

2.10 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting 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.
 - d. Exterior insulation and finish systems.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

#26-016.01

079200 - 8

- a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. 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.

#26-016.01 079200 - 9

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.

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.

#26-016.01

079200 - 10

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 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

#26-016.01

089000 - 1

SECTION 089000 - LOUVERS AND VENTS

GENERAL

SUMMARY

- A. Section Includes:
 - 1. Fixed, extruded-aluminum wall louvers.
 - 2. Wall vents (brick vents).
- B. See Division 8 Section "Steel Doors and Frames" for louvers in hollow-metal doors.
- C. See Division 8 Section "Flush Wood Doors" for louvers in flush wood doors.
- D. See Division 15 Sections for louvers that are a part of mechanical equipment.

PERFORMANCE REQUIREMENTS

- E. Design: Design louvers, including comprehensive engineering analysis by a qualified engineer, using structural performance requirements and design criteria indicated.
- F. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors.
 - 1. Wind Loads: Determine loads based on a uniform pressure of 30 lb./sq. ft. (1435 Pa), acting inward or outward.
- G. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

SUBMITTALS

- H. Product Data: For each type of product indicated.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- I. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
- J. Samples: For each type of metal finish required.
- K. Submittal: For louvers indicated to comply with structural performance requirements and design criteria indicated.

#26-016.01

089000 - 2

- L. Product Test Reports: Based on tests performed according to AMCA 500-L.

PRODUCTS

MATERIALS

- M. Aluminum Extrusions: ASTM B 221M, Alloy 6063-T5.
- N. Aluminum Sheet: ASTM B 209M, Alloy 3003 with temper as required for forming.
- O. Fasteners: Use types and sizes to suit unit installation conditions.
1. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.

FABRICATION, GENERAL

- P. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- Q. Join frame members to each other and to fixed louver blades with fillet welds concealed from view welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

FIXED, EXTRUDED-ALUMINUM LOUVERS

- R. Horizontal Drainable-Blade Louver
1. Basis-of-Design Product: Architectural Louvers Co. (Harray, Inc); Model E4DS. Subject to compliance with requirements, provide the specified product or comparable product by one of the following:
- a. Manufacturers of equivalent products submitted and approved in accordance with Section 01630 - Product Substitution Procedures.
2. Louver Depth: 4 inches (100 mm)
3. Blade Profile: Drainable blade with front gutter for water diversion to jambs
4. Frame and Blade Nominal Thickness: Not less than 0.080 inch (2.03 mm) for blades and frames.
5. Louver Performance Ratings:
- a. Free Area: Not less than 8.96 sq. ft. (0.83 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
- b. Point of Beginning Water Penetration: Not less than 930 fpm (4.7 m/s).
- c. Air Performance: Not more than 0.10-inch wg (25-Pa) static pressure drop at 800 fpm (4.1-m/s) free-area velocity.
- d. Air Performance: Not more than 0.15-inch wg (37-Pa) static pressure drop at 1000-fpm (5.1-m/s) free-area velocity.
6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

#26-016.01

089000 - 3

LOUVER SCREENS

- S. General: Provide screen at each exterior louver.
- T. Louver Screen Frames: Same kind and form of metal as indicated for louver to which screens are attached.
- U. Louver Screening: Same kind of metal as indicated for louver.
 - 1. Bird Screening: Flattened, expanded aluminum, 3/4 by 0.050 inch (19 by 1.27 mm) thick.

ALUMINUM FINISHES

- V. Basis-of-Design: Clear Anodized Aluminum
- W. 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.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

EXECUTION

INSTALLATION

- X. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
- Y. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather-tight connection.
- Z. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- AA. Repair damaged finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory and refinish entire unit or provide new units.
- BB. Protect galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint.

END OF SECTION

#26-016.01

095113 - 1

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 each exposed product and for each color and texture specified, 6 inches in size.
- C. Samples for Initial Selection: For components with factory-applied color finishes.
- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Panel: Set of 6-inch-square 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.

#26-016.01

095113 - 2

- B. Qualification Data: For testing agency.
- C. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.
- E. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 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.

1.7 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.

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.

#26-016.01

095113 - 3

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. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.

C. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.

D. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.

E. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 ACOUSTICAL PANELS

A. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated on Drawings or comparable products by one of the following:

1. Armstrong World Industries, Inc. as basis of design.
2. CertainTeed Corp.
3. Chicago Metallic Corporation.
4. Tectum Inc.
5. USG Interiors, Inc.; Subsidiary of USG Corporation.

B. Color: As indicated on Drawings.

#26-016.01

095113 - 4

- 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.
- 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.
 - 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 0.135-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.

#26-016.01

095113 - 5

- F. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.
- G. 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 Product: Subject to compliance with requirements, provide Prelude 15/16 inch grid manufactured by Armstrong World Industries, Inc. or comparable product by one of the following:
 - 1. Armstrong World Industries, Inc. as basis of design.
 - 2. CertainTeed Corp.
 - 3. Chicago Metallic Corporation.
 - 4. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Wide-Face, Single-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet electrolytically zinc coated, with prefinished flanges of width indicated.
 - 1. Structural Classification: Heavy-duty system.
 - 2. Face Finish: Painted white.

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. as basis of design.
 - 2. CertainTeed Corp.
 - 3. USG Interiors, Inc.; Subsidiary of USG Corporation.
- 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.

#26-016.01

095113 - 6

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.

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."
- 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.

#26-016.01

095113 - 7

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.
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.

#26-016.01

095113 - 8

3. Install hold-down 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

#26-016.01

099000 - 1

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 masonry units (CMUs).
 - 2. Concrete
 - 3. Steel and iron.
 - 4. Galvanized metal.
 - 5. Aluminum (not anodized or otherwise coated).
 - 6. Wood.
 - 7. Plastic.
 - 8. Gypsum board.
 - 9. Acoustic panels and tiles.
 - 10. ASJ insulation covering.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- 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.
 - 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.

#26-016.01

099000 - 2

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 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.

1.6 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.
- 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 in Finish Schedule or comparable 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.

2.2 PAINT, GENERAL

- A. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 150 g/L.
 - 3. Primers, Sealers, and Undercoaters: 200 g/L.

#26-016.01

099000 - 3

4. Floor Coatings: 100 g/L.

B. Colors: As indicated in Finish Schedule on Drawings.

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 Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (Clay and CMUs): 12 percent.
 - 3. Wood: 15 percent.
 - 4. 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.

#26-016.01

099000 - 4

- 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. Steel Substrates: Remove rust, loose mill scale, and shop primer. Clean using methods recommended in writing by paint manufacturer.
- F. 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.
- G. 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.
- H. 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.
- I. 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 entire exposed surface of window frames and sashes.
 - 5. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 6. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 7. 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.

#26-016.01

099000 - 5

- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 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.
- 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:

#26-016.01 099000 - 6

- 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.

#26-016.01

099000 - 7

- 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 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, Previously Painted - High Gloss Latex Enamel:
 - 1. Benjamin Moore:
 - a. Finish: Two coats DTM Acrylic M-28; 2.0 mils dry film thickness each coat.
 - 2. Behr:
 - a. Finish: Two coats Premium Plus Hi-Gloss 8050. 1.4 - 2.2 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 B66-100, 2.5 - 4.0 mils dry film thickness each coat.
- E. 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.

#26-016.01

099000 - 8

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.

F. Concrete - 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. 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.

3. PPG Paints:

- a. Primer: One coat 6-15 Speedhide Acrylic Masonry Block Filler, 5 - 14 mils dry film thickness.
- b. Finish: Finish: Two coats PP649 Acri-Shield Semi-Gloss Acrylic, 1.5 mils dry film thickness each coat.

4. Sherwin-Williams:

- a. Filler: One coat Loxon Block Surfacer, 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.

3.7 SCHEDULE - INTERIOR SURFACES - LATEX

A. Shop Primed Ferrous Metal - Semi-Gloss Latex:

1. Benjamin Moore:

#26-016.01

099000 - 9

- 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.
- 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. Gypsum Board Under Vinyl Wall Covering - Latex Primer:
 1. Benjamin Moore:

#26-016.01 099000 - 10

- a. Primer: One coat Super Spec Latex Enamel Undercoater and Primer Sealer 253; 1.2 mils dry film thickness.
- 2. Behr:
 - a. Primer: One coat Premium Interior All-In-One Primer & Sealer 75. 1.6 mils dry film thickness.
- 3. Dunn Edwards:
 - a. Primer: One coat Ultr Grip W715 Acrylic Multi-Purpose Primer, 1.5 mils dry film thickness.
- 4. Frazee Paint:
 - a. Primer: One coat 065 Acryprime, 1.5 mils dry film thickness.
- 5. PPG Paints:
 - a. Primer: One coat PPG Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer 17-921, 1.6 mils dry film thickness.
- 6. Sherwin-Williams:
 - a. Primer: One coat Premium Wall & Wood Primer, B28W08111, 1.6 mils dry film thickness.
- 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:
 - 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. Dunn Edwards:
 - a. Primer: One coat Viny-Lastic W101 pigmented sealer, 1.5 mils dry film thickness.
 - b. Finish: Two coats Decovel W401 Acrylic Flat, 1.5 dry film thickness.
 - 4. Frazee Paint:
 - a. Primer: One coat 061 Aqua Seal, 1.3 mils dry film thickness.

#26-016.01

099000 - 11

- b. Finish: Two coats 011 Velvin, 1.6 mils dry film thickness each coat.
- 5. 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.
- 6. 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.
- E. Exposed Metal Deck & Joists - Flat Acrylic:
 - 1. Benjamin Moore:
 - a. Finish: One coat M 33 Sweep-Up Spray, Latex Flat; 2.0 mils dry film thickness.
 - 2. Behr:
 - a. Finish: One coat Behr Pro Dryfall Latex Flat 890. 1.8 mils dry film thickness.
 - 3. Dunn Edwards:
 - a. Finish: Two coats Aqua-Fall W6079 Acrylic Dryfall Flat, 2.0 mils dry film thickness.
 - 4. Frazee Paint:
 - a. Finish: One coat Acrylic Dry Fall 504, 3.1 mils dry film thickness.
 - 5. PPG Paints:
 - a. Finish: One coat PPG Speedhide Interior Dry-Fog Spray Paint Flat Vinyl Acrylic Latex 6-715XI, 2.2 mils dry film thickness.
 - 6. Sherwin-Williams:
 - a. Finish: One-two coat Pro Industrial Low VOC Waterborne Acrylic Dry Fall B42W1, 3-4.5 mils dry film thickness.

3.8 SCHEDULE - INTERIOR SURFACES - LATEX, LOW VOC

- A. Gypsum Board: Flat Finish: Gypsum board ceilings.
 - 1. Benjamin Moore:

#26-016.01

099000 - 12

- 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.
- B. Gypsum Board: Semi-Gloss Finish: Gypsum board walls and wayfinding soffits – Eggshell.
 - 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.
- C. 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.

#26-016.01

099000 - 13

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.
- D. Ferrous Metal: Semi-Gloss Finish:
1. Benjamin Moore:
 - a. Primer: One coat IronClad Latex Low Lustre Metal and Wood Enamel 363.
 - 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. 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.
 5. 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.
- E. 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:

#26-016.01

099000 - 14

- a. Filler Coat: Loxon Block Surfacers, A24W200.
- b. Finish: Two coats ProMar 200 Zero VOC Interior Latex Semi-Gloss B31-2600.

END OF SECTION

SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 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. Chain-link fences.
- B. Related Requirements:
 - 1. **Concrete information noted on Structural drawings**

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**.
 - 1. Inspect and discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
 - 2. Review sequence of operation for each type of gate operator.
 - 3. Review coordination of interlocked equipment specified in this Section and elsewhere.
 - 4. Review required testing, inspecting, and certifying procedures.

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 the following:
 - a. Fence and gate posts, rails, and fittings.
 - b. Chain-link fabric, reinforcements, and attachments.
 - c. Gates and hardware.
 - 2. Include plans, elevations, sections, details, and attachments to other work.
 - 3. Include accessories, hardware, gate operation, and operational clearances.
- B. Samples for Initial Selection: For each type of factory-applied finish.

#26-016.01

323113 - 2

- C. Samples for Verification: For each type of component with factory-applied finish, prepared on Samples of size indicated below:
 - 1. Polymer-Coated Components: In 6-inch (150-mm) lengths for components and on full-sized units for accessories.
- D. Delegated-Design Submittal: For structural performance of chain-link fence and gate frameworks, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **professional engineer**.
- B. Retain "Product Certificates" Paragraph below to require submittal of product certificates from manufacturers.
- C. Product Certificates: For each type of chain-link fence, and gate.
- D. Product Test Reports: For framework strength according to ASTM F 1043, for tests performed by manufacturer and witnessed by a qualified testing agency.
- E. Field quality-control reports.
- F. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing fence grounding; member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.9 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to comply with performance requirements.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - c. Faulty operation of gate operators and controls.
 - 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 chain-link fence and gate frameworks.
- B. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated according to **ASCE/SEI 7**.
 - 1. Minimum Post Size: Determine according to ASTM F 1043 for post spacing not to exceed **10 feet (3 m)**.
 - 2. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on mesh size and pattern specified.

2.2 FENCE FRAMEWORK

- A. Posts and Rails **<MATCH EXISTING>**: ASTM F 1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 based on the following:
 - 1. Fence Height: **48 inches**
 - 2. Heavy-Industrial-Strength Material: **Group IA, round steel pipe, Schedule 40**
 - 3. Horizontal Framework Members: **top and bottom** rails according to ASTM F 1043.
 - a. Top Rail: **1.66 inches (42 mm) in diameter**
 - 4. Metallic Coating for Steel Framework:
 - a. Type A: Not less than minimum 2.0-oz./sq. ft. (0.61-kg/sq. m) average zinc coating according to ASTM A 123/A 123M or 4.0-oz./sq. ft. (1.22-kg/sq. m) zinc coating according to ASTM A 653/A 653M.

#26-016.01

323113 - 4

5. Polymer coating over metallic coating.
 - a. Color: **Black**, according to ASTM F 934.

2.3 SWING GATES

- A. General: ASTM F 900 for gate posts and single and double swing gate types.
 1. Gate Leaf Width: **As indicated on the drawings.**
- B. Pipe and Tubing:
 1. Zinc-Coated Steel: ASTM F 1043 and ASTM F 1083; **protective coating and finish to match fence framework**
 2. Gate Posts: **Round tubular steel**
 3. Gate Frames and Bracing: **Round tubular steel**
- C. Frame Corner Construction: **Welded**
- D. Hardware:
 1. Hinges: **180-degree outward** swing.
 2. Latch: Permitting operation from both sides of gate **with provision for padlocking accessible from both sides of gate.**

2.4 FITTINGS

- A. Provide fittings according to ASTM F 626.
- B. Post Caps: Provide for each post.
- C. Rail and Brace Ends: For each gate, corner, pull, and end post.
- D. Rail Fittings: Provide the following:
 1. Rail Clamps: Line and corner boulevard clamps for connecting **top and bottom** rails to posts.
- E. Tension Bars: **Steel** length not less than 2 inches (50 mm) shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.
- F. Tie Wires, Clips, and Fasteners: According to ASTM F 626.
 1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:
 - a. Hot-Dip Galvanized Steel: **galvanized coating thickness matching coating thickness of chain-link fence fabric**

#26-016.01

323113 - 5

G. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. (366 g/sq. m) of zinc.
 - a. Polymer coating over metallic coating.
2. Aluminum: Mill finish.

2.5 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. 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. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
 1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 CHAIN-LINK FENCE INSTALLATION

- A. Install chain-link fencing according to ASTM F 567 and more stringent requirements specified.
- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

#26-016.01

323113 - 6

- C. Post Setting: Set posts **in concrete** at indicated spacing into firm, undisturbed soil.
 - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
 - 2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Concealed Concrete: Place top of concrete below grade **as indicated on Drawings** to allow covering with surface material.
- D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.
- E. Line Posts: Space line posts uniformly
- F. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
- G. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
- H. Bottom Rails: Secure to posts with fittings.
- I. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches (380 mm) o.c.
- J. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.
 - 1. Maximum Spacing: Tie fabric to line posts at 12 inches (300 mm) o.c. and to braces at 24 inches (610 mm) o.c.

3.4 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: **Owner will engage** a qualified testing agency to perform tests.

#26-016.01

323113 - 7

- B. Prepare test reports.

3.6 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware and other moving parts.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain chain-link fences and gates.

END OF SECTION

#26-016.01

220000 - 1

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 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. BES – Beaumont Elementary School
- E. DES – Devon Elementary School
- F. HES – Hillside Elementary School
- G. NEES – Beaumont Elementary School
- H. VFES – Valley Forge Elementary School
- I. VFMS – Valley Forge Middle School
- J. TEMS – Tredfyffrin/Easttown Middle School
- K. CHS – Conestoga High School
- L. NOC – Network Operations Center

1.4 SCOPE OF WORK

- A. The following description of work will use the following abbreviations:
 - 1. General Contractor – GC

#26-016.01

220000 - 2

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 valves and equipment as outlined in contract drawings.
 3. Demolition and removal of all domestic hot and cold water piping as indicated on contract drawings.
 4. Provide new valves and double check valve backflow preventer as outlined in contract drawings.
 5. Provide all domestic hot, cold and recirculation piping, hangers, supports, as needed. Reconnect domestic hot and cold piping and sanitary and vent piping to existing piping where indicated.
 6. Coordinate with GC, MC, and EC for the installation of all domestic water piping to ensure proper elevations, clearances, installation schedules, is performed in an orderly fashion.
 7. Provide insulation of all plumbing equipment and piping.
 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

#26-016.01

220000 - 3

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.

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).

PART 1 - GENERAL

1.1 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. Grout.
 - 7. Equipment installation requirements common to equipment sections.
 - 8. 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, 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 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.

#26-016.01

220500 - 2

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."

#26-016.01

220500 - 3

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.

#26-016.01

220500 - 4

- 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.
- b. Precision Plumbing Products, Inc.

#26-016.01

220500 - 5

- 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 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.

#26-016.01

220500 - 6

- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at 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.

#26-016.01

220500 - 7

- 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.
- 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.

#26-016.01

220500 - 8

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.
- 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 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.

3.6 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.

#26-016.01

220500 - 9

- C. Attach to substrates as required to support applied loads.

3.7 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

PART 1 - GENERAL

1.1 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. Stainless Steel, single-flange butterfly 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:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.

#26-016.01

220523 - 2

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. Handwheel: For valves other than quarter-turn types.
 2. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
 3. 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. Solder Joint: With sockets according to ASME B16.18.
- G. Valve Bypass and Drain Connections: MSS SP-45.

#26-016.01

220523 - 3

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 STAINLESS STEEL, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Stainless Steel, Flanged 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. NIBCO INC.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-68
 - b. CWP Rating: 150 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 351, 316 Stainless Steel.
 - e. Seat: PTFE.
 - f. Stem: 316 stainless steel.
 - g. Disc: 316 Stainless steel.

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.
 - 3. Throttling Service: Ball or butterfly 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.

#26-016.01

220523 - 5

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 3 and Smaller:

1. Ball Valves: Two piece, full port, bronze with stainless-steel ball and trim.

B. Pipe NPS 4 and larger:

1. Stainless Steel, Single-Flange Butterfly Valves: 150 CWP, stainless-steel disc.

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 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.

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.
- C. Welding certificates.

#26-016.01

220529 - 2

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.

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.

#26-016.01

220529 - 3

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.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

#26-016.01

220529 - 4

- 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.
 - 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.

#26-016.01

220529 - 5

- 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. 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.
 - 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.
 - 4. factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
- 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 fastener or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- N. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

#26-016.01

220529 - 6

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.
- 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.

#26-016.01

220529 - 7

- 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.
 - 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.
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 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.4 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

PART 1 - GENERAL

1.1 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. 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. Valve numbering scheme.
- D. 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 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.

#26-016.01

220553 - 2

- 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 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.

3.3 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

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. Insulation Materials:
 - a. 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.

#26-016.01

220700 - 2

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.

#26-016.01

220700 - 3

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.
 - 5. Color: White.

#26-016.01

220700 - 4

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.

#26-016.01

220700 - 5

- 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.

- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
2. Width: 2 inches.
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.

#26-016.01

220700 - 6

- 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.

#26-016.01

220700 - 7

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.

#26-016.01

220700 - 8

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.

#26-016.01

220700 - 9

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.
 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

#26-016.01

220700 - 10

- 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.
- 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:
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.

#26-016.01

220700 - 11

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. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. 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:

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.

#26-016.01

220700 - 12

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

PART 1 - GENERAL

1.1 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.
- 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:
 - 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.

#26-016.01

221116- 2

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 (ASTM B 88M, Type B) 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 Pressure-Seal-Joint Fittings:
 - 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) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

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: Stainless 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.

#26-016.01

221116- 3

- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

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:

#26-016.01

221116- 4

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.
 - 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 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.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

#26-016.01

221116- 5

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.

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. 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."

#26-016.01

221116- 6

- D. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2144. 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.
- E. 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.
- F. 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 valves for piping NPS 3 and larger.

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.

#26-016.01

221116- 7

- 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.
 - 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:

#26-016.01

221116- 8

1. 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.
- 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 in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.10 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.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 2. Test for leaks and defects in new piping 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.

#26-016.01

221116- 9

- E. Prepare test and inspection reports.

3.12 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. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
7. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.13 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:
 - 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.

3.14 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.

#26-016.01

221116- 10

- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Aboveground domestic water piping shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and soldered joints.
 - 2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); copper pressure-seal-joint fittings; and pressure-sealed joints.

3.15 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 3 and smaller. Use butterfly valves with flanged ends for piping NPS 4 and larger.

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 domestic water piping specialties:
 - 1. Backflow preventers.

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."

PART 2 - PRODUCTS

2.1 BACKFLOW PREVENTERS

- A. Double-Check, Backflow-Prevention Assemblies
- DOMESTIC WATER PIPING SPECIALTIES

#26-016.01

221119- 2

1. Manufacturers:
 - a. Zurn: Model 350AST
2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Body: 304L stainless steel.
5. Internals: Stainless Steel, 300 Series NORYL
6. Fasteners and Springs: Stainless Steel, 300 Series
7. Seal Ring: EPDM
8. O-ring: Buna Nitrile
9. End Connections: Flanged
10. Configuration: Designed for horizontal, straight-through or vertical flow.
11. Accessories:
 - a. Valves NPS 2-1/2 and Larger: NRS gate type with flanged ends on inlet and outlet.

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 system. Comply with authorities having jurisdiction.
 1. Do not install bypass piping around backflow preventers.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

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. Backflow preventers.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 1. Test each 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.

END OF SECTION

#26-016.01

230000 - 1

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.
- D. BES – Beaumont Elementary School
- E. DES – Devon Elementary School
- F. HES – Hillside Elementary School
- G. NEES – Beaumont Elementary School
- H. VFES – Valley Forge Elementary School
- I. VFMS – Valley Forge Middle School
- J. TEMS – Tredfyffrin/Easttown Middle School
- K. CHS – Conestoga High School
- L. NOC – Network Operations Center

1.4 SCOPE OF WORK

- A. The following description of work will use the following abbreviations:

#26-016.01

230000 - 2

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. Remove existing roof top units and all associated, controls.
2. Remove existing air handling units and all associated controls, piping, ductwork and insulation to points indicated.
3. Remove existing burners and all associated controls & gas piping to points indicated.
4. Remove exhaust fans and all associated controls.
5. Provide and install new roof top units and all associated controls, duct mounted hot water coil, hot water branch piping (where indicated), and ductwork.
6. Provide and place all roof curbs and roof rails. Coordinate locations with the General Contractor. General Contractor is responsible for installing and flashing and creating roof penetrations.
7. Provide and install new split system air conditioning units and all associated hangers, supports, refrigerant piping, insulations, controls and wiring.
8. Provide and install new air handling units and all associated ductwork, hangers, supports, insulation, hot water supply and return piping, fittings, valves, controls and wiring.
9. Provide and install new exhaust fans and associated ductwork, hangers, supports, dampers, grilles, roof curbs, and controls and wiring.
10. Provide controls upgrades at Devon Elementary School and West Valley Administration Building as indicated in specification 230900 Instrumentation and Control for HVAC.
11. Provide all new piping, ductwork, & equipment insulation.
12. Provide complete system balancing at the completion of the project per contract specifications.
13. Provide all associated control equipment required unless otherwise noted.
14. Providing all necessary permits, approvals, fees, etc.
15. Provide instructions to the owner as outlined in these Specifications.
16. Provide all cutting and patching as required to perform the work of this contract.
17. Provide all necessary rigging as required to perform the work of this contract.
18. Provide manufacturer startup for all systems specified as outlined in these Specifications.
19. Provide removal of trash and general clean-up.
20. Provide as-built drawings.
21. Provide operation and maintenance manuals.
22. Employ the services of the local Underwriters' Inspection Agency and pay for all associated fees.
23. Completion Date: All HVAC work shall be completed on the date of substantial completion for the project as set in the Division 1 specifications.
24. 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.

C. 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.

D. 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

#26-016.01

230000 - 3

scope of his work.

- E. 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 Contractor's Proposal.
- F. 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.
- G. 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.
- H. 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.

#26-016.01

230000 - 4

- 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.
- 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).

#26-016.01

230000 - 5

END OF SECTION

SECTION 230130 – HVAC AIR-DISTRIBUTION SYSTEM CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cleaning HVAC air-distribution equipment, ducts, plenums, and system components.

1.3 DEFINITIONS

- A. ASCS: Air systems cleaning specialist.
- B. NADCA: National Air Duct Cleaners Association.
- C. VISIBLY CLEAN: Determined by internal Visual Inspection, that all portions or components of the ACS are both 1) free of any Debris, and 2) in the cleaner's professional judgement, capable of Cleaning Verification.
- D. FAN: A power driven machine which moves a volume of air by converting rotational mechanical energy to an increase in the total pressure of the moving air. (See AMCA 99-86)
- E. MECHANICAL CLEANING:
 - 1. Physical removal of Debris and other foreign matter from ACS surfaces.
 - 2. Clean metal-duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - 3. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of ducts so areas being cleaned are under negative pressure.
 - 4. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts or duct liner. Mechanical Agitation shall include devices such as the AIRE-SWEEP Power Brush (or Duct Whip for smaller ducts).
- F. NADCA VACUUM TEST (Requirement for each of the Contract Cleaning Areas): A measurable performance test to verify the cleanliness of any Non-Porous surface of an ACS, in which loose Debris is collected from a defined area within an ACS, using the vacuum equipment and method specified in Appendix A of this standard. This collected Debris is weighed to determine the amount present in the specified area.
- G. NON-POROUS ACS SURFACE: Any surface of the ACS in contact with the air stream which cannot be penetrated by either solutions or air. This would exclude materials such as wood, fiberboard, thermal insulation, and concrete.

#26-016.01

230130 - 2

- H. PARTICULATE COLLECTION EQUIPMENT: A device used for collecting and containing particulate material.
- I. PRESSURE DROP: Loss in pressure, as from one end of a refrigerant line to the other, from friction, static, heat, etc. Difference in pressure between two points in a flow system, usually caused by frictional resistance to fluid flow in a conduit, filter, or other flow system. (See ASHRAE Terminology of HVAC Systems and Equipment)
- J. STATIC PRESSURE: The normal force per unit area that is exerted on the interior surfaces of the ACS by the air.
- K. VISIBLY CLEAN: Determined by internal Visual Inspection, that all portions or components of the ACS are both 1) free of any Debris (see 3.3), and 2) in the cleaner's professional judgement, capable of Cleaning Verification (see 6.2, 6.3).
- L. VISUAL INSPECTION: Examination of the cleaned components of the ACS to evaluate the effectiveness of the cleaning process using the human eye or another optical instrument.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For an ASCS.
- B. Strategies and procedures plan.
- C. Cleanliness verification report.

1.5 HEALTH AND SAFETY

- A. Cleaning contractors shall comply with all applicable federal, state, and local requirements for protecting the safety of the contractor's employees, building occupants, and the environment. In particular, all applicable standards of the Occupational Safety and Health Administration (OSHA) should be followed when working in accordance with this standard.
- B. No processes or materials shall be employed in such a manner that they will create adverse health effects to the building occupants, cleaning contractors, or general public.
- C. Disposal of Debris. All Debris removed from the ACS shall be disposed of in accordance with all applicable federal, state, and local requirements.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.

#26-016.01

230130 - 3

- B. Prepare written report listing conditions detrimental to performance of the Work.
- C. Proceed with work only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare a written plan that includes strategies and step-by-step procedures. At a minimum, include the following:
 - 1. Supervisor contact information.
 - 2. Work schedule including location, times, and impact on occupied areas.
 - 3. Methods and materials planned for each HVAC component type.
 - 4. Required support from other trades.
 - 5. Equipment and material storage requirements.
- B. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.
- C. Comply with NADCA ACR, "Guidelines for Constructing Service Openings in HVAC Systems" Section.

3.3 CLEANING

- A. Comply with NADCA ACR.
- B. Remove visible surface contaminants and deposits from within the HVAC system.
- C. Systems and Components to Be Cleaned:
 - 1. Conestoga HS: All existing HVAC system ductwork shown on drawings M203 & M205 for system:
 - a. AHU-11
 - b. EF-5
 - c. (E)EF-57 and (E)EF-68
 - d. Return chases for AHU-9, AHU-10 and AHU-11.
 - e. Ductwork to be cleaned:
 - 1) Supply-air ducts, including turning vanes.
 - 2) Return-air ducts to the air-handling unit.
 - 3) Exhaust-air ducts.
 - 4) Transfer ducts.
- D. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- E. Particulate Collection:
 - 1. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.
 - 2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building.

#26-016.01

230130 - 4

- F. Control odors and mist vapors during the cleaning and restoration process.
- G. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.
- H. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.
- I. Clean visible surface contamination deposits according to NADCA ACR and the following:
 - 1. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.
 - 2. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.
 - 3. Clean evaporator coils, reheat coils, and other airstream components.
- J. Duct Systems:
 - 1. Create service openings in the HVAC system as necessary to accommodate cleaning.
 - 2. Mechanically clean duct systems specified to remove all visible contaminants so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR).
- K. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.
- L. General Requirements:
 - 1. Containment. Debris removed during cleaning shall be collected and precautions must be taken to ensure that Debris is not otherwise dispersed outside the ACS during the cleaning process. After ACS cleaning, any areas which could be affected by the cleaning contractor=s work must be as clean or cleaner than their condition prior to the commencement of the cleaning operation.
 - 2. Particulate Collection. Where the Particulate Collection Equipment is exhausting inside the building, HEPA filtration with 99.97% collection efficiency for 0.3-micron size particles shall be used (See EPA=s Building Air Quality). When the Particulate Collection Equipment is exhausting outside the building, Mechanical Cleaning operations shall be undertaken only with Particulate Collection Equipment in place, including adequate filtration to contain Debris removed from the ACS. When the Particulate Collection Equipment is exhausting outside the building, precautions shall be taken to ensure that exhausted air does not re-enter the building.
 - 3. Filtration Integrity. When using Particulate Collection Equipment exhausting inside the building, contractors shall be able to certify equipment effectiveness of 99.97% collection efficiency for 0.3 -micron size particles through DOP test results, from an independent testing agency, for any collection device intended for use on a particular job.
 - 4. Controlling Odors. All reasonable measures shall be taken to control offensive odors and/or mist vapors during the cleaning process.
 - 5. Component Cleaning. Cleaning methods shall be employed such that all Non-Porous ACS Surface components must be Visibly Clean (see Section 1.3). Upon completion, all components must be returned to those settings recorded just prior to cleaning operations.
 - 6. Air-Volume Control Devices. Dampers and any air-directional mechanical devices inside the ACS must have their position marked prior to cleaning and, upon completion, must be restored to their marked position.
 - 7. Provide access door for mechanical agitation cleaning at a minimum of every 20' of ductwork. Any access holes cut for the mechanical agitation cleaning process must be repaired so that they shall not significantly alter the airflow. All openings made to facilitate the cleaning must be sealed in accordance with industry standards and local codes, using materials acceptable under

#26-016.01

230130 - 5

those standards and codes. (See SMACNA's HVAC Duct Construction Standards - Metal and Flexible.) All duct access holes cut for the power brush cleaning shall be repaired by the placement of a "Duct Access Door" as defined in Specification Section 233300. Do not cut new access panels in exterior ductwork. Utilize a "Duct Whip" or compressed air for agitation if any external areas are unreachable by a brush. Seal any required penetrations weather tight with matching board insulation and a Venture Tape patch.

8. There are duct mounted smoke detectors in areas under this contract that will be affected by the cleaning. Contract requirements include complete isolation of the detector sample tubes such that no particulate enters or becomes lodged in the tubes. Isolation shall be in the form of a pressure resistant plastic cover. Notify owner 7 days before zone cleaning operations will begin with a dedicated time frame so that they can place the fire alarm system in "stand-by" during the cleaning operation and reactivate once cleaning is complete and the contractor has removed the plastic covering from the affected sample tubes.

M. Mechanical Cleaning Methodology:

1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.
 - a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
 - b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials such as duct and plenum liners.
2. Cleaning Mineral-Fiber Insulation Components:
 - a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR.
 - b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR).
 - c. Fibrous materials that become wet shall be discarded and replaced.

N. Antimicrobial Agents and Coatings:

1. Apply antimicrobial agents and coatings if active fungal growth is reasonably suspected or where unacceptable levels of fungal contamination have been verified. Apply antimicrobial agents and coatings according to manufacturer's written recommendations and EPA registration listing after the removal of surface deposits and debris.
2. When used, antimicrobial treatments and coatings shall be applied after the system is rendered clean.
3. Apply antimicrobial agents and coatings directly onto surfaces of interior ductwork.
4. Sanitizing agent products shall be registered by the EPA as specifically intended for use in HVAC systems and ductwork.

#26-016.01

230130 - 6

3.4 CLEANLINESS VERIFICATION

- A. Verify cleanliness according to NADCA ACR, "Verification of HVAC System Cleanliness" Section.
- B. Verify HVAC system cleanliness after mechanical cleaning and before applying any treatment or introducing any treatment-related substance to the HVAC system, including biocidal agents and coatings.
- C. Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
- D. Prepare a written cleanliness verification report. At a minimum, include the following:
 - 1. Written documentation of the success of the cleaning.
 - 2. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.
 - 3. System areas found to be damaged.

3.5 RESTORATION

- A. Restore service openings capable of future reopening. Comply with requirements in Section 15815 "Metal Ducts." Include location of service openings in Project closeout report.
- B. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing. Comply with requirements in Section 233113 "Metal Ducts."
- C. Replace damaged insulation according to Section 230700 "HVAC Insulation."
- D. Ensure that closures do not hinder or alter airflow.
- E. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.

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:
 - 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. Welding Criteria & Testing.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:

#26-016.01

230500 – 2

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.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

#26-016.01

230500 – 3

- 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.
 - 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.

#26-016.01

230500 – 4

- 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, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 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:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.

#26-016.01

230500 – 5

- 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.

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.

#26-016.01

230500 – 6

- 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.

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.

#26-016.01

230500 – 7

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.
- 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.

#26-016.01

230500 – 8

- 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:
 - 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.

#26-016.01

230500 – 9

- 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.
- 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.

#26-016.01

230500 – 10

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.

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.

#26-016.01

230500 – 11

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.

3.9 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:

#26-016.01

230500 – 13

- 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 racks, 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.

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 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.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.

#26-016.01

230513 - 2

- 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.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

#26-016.01

230513 - 3

- 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

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Liquid-in-glass thermometers.
 - 2. Thermowells.
 - 3. Dial-type pressure gages.
 - 4. Gage attachments.
 - 5. Test plugs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. H.O. Trerice Company.
 - b. Weiss Instruments.
 - c. Moeller Instruments.

#26-016.01

230519 – 2

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass or plastic.
8. Stem: Aluminum and of length to suit installation.
 - a. Design for Air-Duct Installation: With ventilated shroud.
 - b. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. H.O. Trerice Company.
 - b. Weiss Instruments.
 - c. Moeller Instruments.
2. Standard: ASME B40.100.
3. Case: Liquid filled type, stainless steel, 4-1/2-inch diameter.
4. Pressure-Element Assembly: Bronze tube, unless otherwise indicated.
5. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.

#26-016.01

230519 – 3

8. Pointer: Red or other dark-color metal.
9. Window: Acrylic.
10. Ring: 304 Stainless Steel.
11. Fill: Glycerine
12. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
13. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
14. Range for Fluids under Pressure: Two times operating pressure and minimum 100 psi. Provide minimum 125 psi gauges at all expansion tanks.
15. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball, with NPS 1/4, ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. H.O. Trerice Company.
 - b. Weiss Instruments.
 - c. Moeller Instruments.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.

- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gage for fluids.
- H. Install test plugs in piping tees.
- I. Install connection fittings in accessible locations for attachment to portable indicators.
- J. Install thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic zone.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each hydronic zone shall be the following:
 - 1. Industrial-style, liquid-in-glass type.
- B. Thermometers at inlet and outlet of each unit ventilator shall be the following:
 - 1. Test plug with EPDM self-sealing rubber inserts.
- C. Thermometers at inlet and outlet of each cabinet unit heater shall be the following:
 - 1. Test plug with EPDM self-sealing rubber inserts
- D. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Heating, Hot-Water Piping: 30 to 240 deg F.

#26-016.01

230519 – 5

3.6 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at suction and discharge of each pump shall be one of the following:
1. Sealed, direct-mounted, metal case.
 2. Test plug with EPDM self-sealing rubber inserts.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Heating, Hot-Water Piping: 0 to 100 psi.

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. Bronze ball valves.
 - 2. High-performance butterfly valves.
- B. Related Sections:
 - 1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Non-rising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:

#26-016.01

230523 – 2

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Handlever: For quarter-turn valves NPS 6 and smaller.

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. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

#26-016.01

230523 – 3

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO 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: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.3 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, High-Performance Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jamesbury
2. Description:
 - a. Standard: MSS SP-68.
 - b. CWP Rating: 285 psig at 100 deg F.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: Stainless steel.
 - e. Seat: Jamesbury Xtreme seat & carbon-filled enhanced PTFE seal.
 - f. Stem: Stainless steel; offset from seat plane.
 - g. Disc: Stainless steel.
 - h. Service: Bidirectional.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for butterfly NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

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.
- 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.

#26-016.01

230523 – 5

2. For Steel Piping, NPS 2-1/2 and Larger: Flanged ends.

3.5 VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 1. Ball Valves: Two piece, full port, bronze with bronze trim.
- B. Pipe NPS 2-1/2 and Larger:
 1. High Performance butterfly valve Class 150.

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 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.

- B. Welding certificates.

#26-016.01

230529 - 2

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.

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.

#26-016.01

230529 - 3

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.

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.

#26-016.01

230529 - 4

- 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.

#26-016.01

230529 - 5

- 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.

#26-016.01

230529 - 6

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.
- 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.

#26-016.01

230529 - 7

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

PART 1 - GENERAL

1.1 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.

#26-016.01

230553 – 2

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.

#26-016.01

230553 – 3

- 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.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

#26-016.01

230553 – 4

- 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.
- B. Locate equipment labels where accessible and visible.

#26-016.01

230553 – 5

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. Heating and Dual Temperature Water Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
 - 2. 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.

#26-016.01

230553 – 6

- b. Hot Water and Dual Temperature: 1-1/2 inches, round.
- 2. Valve-Tag Color:
 - a. Refrigerant: Natural.
 - b. Hot Water and Dual Temperature: Natural.
- 3. Letter Color:
 - a. Refrigerant: Black.
 - b. Hot Water and Dual Temperature: 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

PART 1 - GENERAL

1.1 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.
 - 2. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic 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.

#26-016.01

230593 - 2

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 and water 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.
- 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.

#26-016.01

230593 - 3

- 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.
 - 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.

#26-016.01

230593 - 4

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, 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.
- 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.

#26-016.01

230593 - 5

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.
 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.

#26-016.01

230593 - 6

- 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.

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

#26-016.01

230593 - 7

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.

#26-016.01

230593 - 8

- 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.
 - 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.
 - m. Entering- and leaving-water temperature.
 - n. Water flow rate.
 - o. Water pressure drop.

#26-016.01

230593 - 9

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. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

- a. System and air-handling-unit identification.
- b. Location and zone.
- c. Room or riser served.
- d. Coil make and size.
- e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm.
- b. Entering-water temperature in deg F.
- c. Leaving-water temperature in deg F.
- d. Water pressure drop in feet of head or psig.
- e. Entering-air temperature in deg F.
- f. Leaving-air temperature in deg F.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

- a. System identification.
- b. Location.
- c. Make and type.

#26-016.01

230593 - 10

- 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.
 - 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.
- I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 - 1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - 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.
- J. 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..

#26-016.01

230593 - 11

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.
- f. Final velocity in fpm.
- g. Space temperature in deg F.

K. 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 water flow of at least 5 percent of terminals
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Verify that balancing devices are marked with final balance position.
 - e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by 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.

#26-016.01

230593 - 12

- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
 - 1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 - 2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports.

3.12 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

PART 1 - GENERAL

1.1 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.

- C. Qualification Data: For qualified Installer.

#26-016.01

230700 - 2

- 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.

#26-016.01

230700 - 3

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:
 - a. Fibrex Insulations Inc.; Coreplus 1200.

#26-016.01

230700 - 4

- 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.

- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

#26-016.01

230700 - 5

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.
 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.

#26-016.01

230700 - 6

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.

#26-016.01

230700 - 7

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.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

#26-016.01

230700 - 8

- a. Airex: Eflexguard.
 - b. Childers Products, Division of ITW
 - c. Foster Products Corporaion
 - 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.

- 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:

#26-016.01

230700 - 9

- 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.
 - 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:

#26-016.01

230700 - 10

- 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.
- 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.

#26-016.01

230700 - 11

- 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:
 - 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.

#26-016.01

230700 - 12

- 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:
 - 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.

#26-016.01

230700 - 13

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.
 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.

#26-016.01

230700 - 14

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.
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.

#26-016.01

230700 - 15

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.
- 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.

#26-016.01

230700 - 16

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.
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.

#26-016.01

230700 - 17

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:
 - 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.

#26-016.01

230700 - 18

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.
- 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.

#26-016.01

230700 - 19

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.
 - 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 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.

#26-016.01

230700 - 20

- B. Round, supply-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 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, unconditioned outdoor-air duct insulation shall be one of the following:
 - 1. Mineral-Fiber Blanket: 3 inches thick and 0.75-lb/cu. ft. nominal density.
 - 2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.
- F. 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.
- G. 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.

3.15 INDOOR PIPING INSULATION SCHEDULE

- A. Heating-Hot-Water Supply and Return, 200 Deg F and below:
 - 1. NPS 1-1/2 and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 2 inch thick.
 - 2. NPS 1-1/4 and Smaller: Insulation shall be the following:
- B. Chilled Water, Brine and Dual Temperature, above 40 Deg F:
 - 1. NPS 12 and Smaller: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 2 inch thick.

#26-016.01

230700 - 21

- C. 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.
- D. Refrigerant Liquid and Suction Flexible Tubing for ductless split systems:
 - 1. Refer to specification Division 23 Section "Refrigerant Piping" for pre-insulated pipe sets.

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.

3.17 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Exposed:
 - 1. PVC: 20 mils thick, in color white.

3.18 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

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. Scope of work include controls upgrades at Devon Elementary School and West Valley Administration Building. Upgrades include all labor, materials, engineering, services and as-builts record drawings to replace the current obsolete i2 BAS controllers with multi-Purpose ethernet based Schneider Electric EcoStruxure controllers. All quantities listed below shall be confirmed by the ATC contractor at the time of bid so that bid pricing includes current obsolete device quantities requiring upgrade.

1. Devon Elementary School Scope:

- a. Existing Andover Continuum BAS Field Controllers:
 - 1) Remove all existing Andover Continuum field controllers that will be replaced with (78) ethernet based Schneider EcoStruxure controllers.
 - 2) Replace all existing thermostats and humidity sensors with (67) Schneider combo temp/humidity Living Sensors.
 - 3) All other existing support devices field sensors and enclosures will remain in operation.
- b. Communication BUS
 - 1) Replace existing RS485 twisted pair BUS with ethernet high speed communication cabling.
 - 2) (2) Switches will be used to create the system architecture.
 - 3) (0) Sub-Panels will be provided and installed where panels cannot fit a switch.
- c. Startup & Checkout:
 - 1) Provide software / hardware start-up and checkout.

2. West Valley Administration Building Scope:

- a. Existing Andover Continuum BAS Field Controllers:
 - 1) Remove all existing Andover Continuum field controllers that will be replaced with (23) ethernet based Schneider EcoStruxure controllers.
 - 2) Replace all existing thermostats and humidity sensors with (16) Schneider combo temp/humidity Living Sensors.
 - 3) All other existing support devices field sensors and enclosures will remain in operation.
- b. Communication BUS
 - 1) Replace existing RS485 twisted pair BUS with ethernet high speed communication cabling.

#26-016.01

230900 - 2

- 2) (2) Switches will be used to create the system architecture.
- 3) (0) Sub-Panels will be provided and installed where panels cannot fit a switch.
- c. Startup & Checkout:
 - 1) Provide software / hardware start-up and checkout.

D. 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.
 - 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.

#26-016.01

230900 - 3

- 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.

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.

#26-016.01

230900 - 4

PART 2 - PRODUCTS – Ecostruxture

- 2.1 Manufacturer: To be a direct and seamless integration into the districts existing Tri-M control system.
- A. The Tri-M Group LLC., Kennett Square Office
1. Contact: Dan Rose,
Phone: 484-584-0730
Email: drose@tri-mgroup.com
- 2.2 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 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.

#26-016.01

230900 - 5

- 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.

2.3 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 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)

#26-016.01

230900 - 6

- 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
 - 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.

#26-016.01

230900 - 7

- 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

- 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:

#26-016.01

230900 - 8

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

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

#26-016.01

230900 - 9

- 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.
- 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

#26-016.01

230900 - 10

- 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.
- 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.

#26-016.01

230900 - 11

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.
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

#26-016.01

230900 - 12

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.

2.4 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.

#26-016.01

230900 - 13

- 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
 - 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:

#26-016.01

230900 - 14

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):

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.

#26-016.01

230900 - 15

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)
 - 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

#26-016.01

230900 - 16

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:

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.

#26-016.01

230900 - 17

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.

2.5 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

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.

#26-016.01

230900 - 18

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. Manual 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:
 - 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):

#26-016.01

230900 - 19

- 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
 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

#26-016.01

230900 - 20

- 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 ± 0.2 °C (± 0.4 °F) selectable for 0.1 or 1 degree display resolution of °F or °C. Sensing Element: 10k Type 3 Thermistor, Accuracy of ± 0.2 °C (± 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: ± 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: ± 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
- 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

2.6 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.

#26-016.01

230900 - 21

- 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 of the alarm message.
 - 2) Support alarm acknowledgement from any BACnet OWS that supports the BACnet service for executing alarm/event acknowledgement,
- 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.

#26-016.01

230900 - 22

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
 - 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.
- 2.7 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.

#26-016.01

230900 - 23

- 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.

2.8 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

2.9 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.

2.10 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.

#26-016.01

230900 - 24

2.11 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.

2.12 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.
- 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.

#26-016.01

230900 - 25

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.
- 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.

#26-016.01

230900 - 26

2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
 3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
 4. Control System Inputs and Outputs:
 - a. Check analog inputs at 0, 50, and 100 percent of span.
 - b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
 - c. Check digital inputs using jumper wire.
 - d. Check digital outputs using ohmmeter to test for contact making or breaking.
 - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
 5. Flow:
 - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
 - b. Manually operate flow switches to verify that they make or break contact.
 6. Pressure:
 - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
 - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
 7. Temperature:
 - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
 - b. Calibrate temperature switches to make or break contacts.
 8. Stroke and adjust control valves and dampers 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

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 sequences for HVAC systems, subsystems, and equipment.
- B. Related Sections include the following:
 - 1. Division 23 Section "HVAC Instrumentation and Controls" for control equipment and devices and for submittal requirements.

1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. LAN: Local Area Network

1.4 **Beaumont Elementary School: RTU-2 & RTU-3**

- A. **Single zone VAV:** The unit shall be configured for single zone VAV operation and shall be provided with VFD drives. Zone temperature shall be controlled via a sequenced DAT reset and fan speed control. The unit controller shall use zone temperature to automatically select heating or cooling mode. Heating and cooling demand shall be calculated through independent heating and cooling PID outputs. These PIDs shall have individually adjustable interval, bias, and proportional, integral, and derivative parameters carefully tuned in each application for slow action to avoid hunting of fan speed drives. The discharge air temperature shall first be reset depending on zone heating or cooling demand with fan operating at min airflow/speed. Then supply air fan will modulate through its min and max speed range to maintain the zone temperature setpoint as described below.
- B. **Occupied mode:** Supply fan shall run continuously with OA damper in its minimum position. The unit controller shall measure the supply air temperature and modulate the heating and cooling to maintain its heating and cooling space setpoint. The operator will be able to adjust the unit start/stop times using the operator's workstation. The BAS will monitor the status of the fan and generate an alarm if the fan fails to respond to a start/stop command. The outdoor air damper shall have proportional control which shall modulate the damper proportionally with fan speed to maintain minimum outside airflow throughout the range of fan airflow.
- C. **Economizer mode:** BAS controller shall permit air-side economizer operation when outdoor air is less than 65°F but greater than 55°F. Economizer shall only operate when the room is in the cooling mode with outside relative humidity between 40% and 50%. When conditions for economizer cooling are satisfied, the outdoor air damper will modulate to maintain the discharge air temperature to its target. On

#26-016.01

230993 - 2

a rise in discharge air temperature above target, the outdoor air damper will modulate open. The reverse will occur on a fall in discharge air temperature below target.

- D. **Occupancy override:** The space temperature sensor will have a pushbutton that, when pressed during the unoccupied mode, will index the equipment to an occupied mode for a period of 2 hours (adjustable).
- E. **Unoccupied mode:** When the unit is shut down by either a stop command or system safety, the unit will be set as follows: supply fan will be off, outdoor air damper closed, return air damper open, and DX cooling off. Unit shall cycle if space temperature falls below the unoccupied setpoint in heating mode (adj.) and above unoccupied cooling mode (adj.) with outside air damper closed. The unit will de-energize when the space temperature is at least 4°F above the unoccupied heating setpoint. Unoccupied cooling is identical to the occupied operation except only one stage of cooling is the active stage.
- F. **DX cooling:** On a rise in average space temperature above the average cooling setpoint (adj.), the first stage of cooling shall be activated. The unit controller shall modulate the compressor to maintain the unit discharge target temperature. The discharge target temperature shall be reset based on space temperature setpoint being maintained by increasing or decreasing discharge temperature. Modulation of cooling shall be configured subject to user-adjustable minimum run times, minimum off times, modulating up, and modulating down delays.
1. First stage – Cooling DAT reset: The unit controller shall first reset the DAT from max 70°F (adj.) to min 55°F (adj.) while supply air flow stays at min fan speed setpoint of 60% (adj.). The unit controller shall modulate the digital compressor to maintain the DAT setpoint.
 2. Second stage – Increase airflow: Upon continued zone temperature above setpoint (cooling PID output increasing from 60–100%), increase supply airflow setpoint from min to max balanced VFD speed setpoint.
 3. Reverse shall occur as zone temperature drops below cooling setpoint.
 4. The digital compressor continues to modulate during the entire cooling operation.
 5. If the economizer is enabled, it will function as the first stage of cooling.
- G. **Dehumidification:** When space humidity sensor goes above 55% RH (adj.), the supply fan shall maintain a constant 60% (adj.) speed and the BAS shall enable hot gas reheat and modulate digital compressor to maintain the suction pressure setpoint (adj.) and modulate hot gas reheat to maintain RTU discharge air target. Logic must be set to make cooling or dehumidification the priority. If any zone is more than 1°F below setpoint and reheat has been running for more than 5 minutes, the associated duct-mounted hot water heating coil shall be enabled to provide additional reheat.
1. Once in dehumidification, the unit will maintain the evaporator coil suction temperature at the coil suction temperature setpoint by modulating the digital compressor (1.5–5.0 VDC operation).
 2. To stage down the extra compressors, the evaporator coil suction temperature needs to be below the evaporator coil suction temperature setpoint and the digital compressor needs to be at 0% for a period of time equal to the staging down delay.
 3. Reheat is always controlled to the active supply air temperature setpoint.
 4. Coil suction temperature setpoint reset: During dehumidification, the system will automatically reset the coil suction temperature setpoint within a ±5° range based on the space or return air humidity sensor condition changing ±5% from the humidity setpoint.
- H. **Morning warm-up:** On occupied days, the system will initiate morning warm-up cycle ½ hour before scheduled occupancy. The process will initiate supply fan and hot water heat to reach occupied setpoint without outdoor air damper open. Freeze protection will be active during this operation.
- I. **Occupied heating mode by (E)Duct mounted heating coil (RTU-2 only):** When zone temperature drops below heating deadband setpoint, unit control shall be indexed to heating mode and cooling shall be disabled.

#26-016.01

230993 - 3

1. First stage – Heating DAT reset: The unit controller shall first reset DAT from min 70°F (adj.) to max 85°F (adj.) while supply air flow stays at min fan speed setpoint of 60% (adj.). The unit controller shall modulate the reheat valve to maintain its DAT setpoint.
 2. Second stage – Increase airflow: Upon continued zone temperature below setpoint, heating PID output increasing from 60–100% shall increase supply airflow setpoint from min to max balanced VFD speed.
 3. Reverse shall occur as zone temperature rises above heating setpoint.
 4. Heating mode is available when the OAT is below the OAT heating upper limit of 65°F (adj.), and there is a demand for heating.
 5. Low temperature protection: A low temperature detector directly after the heating coil de-energizes the supply fan when temperatures below 38°F are sensed. All dampers (OA damper shall close/RA damper shall open) and hot water coil shall open to full coil flow when freezestat senses 38°F.
- J. **Occupied heating mode by (E)Duct mounted heating coil (RTU-3 only):** AHU shall index to 100% speed. On a fall in zone temperature below the heating setpoint (adj.), the heating coil control valve shall modulate to maintain the discharge target of 85°F (adj.). The discharge target shall be reset based on space temperature. On a rise in space temperature above setpoint, the heating coil control valve will modulate closed.
1. Heating mode is available when the OAT is below the OAT heating upper limit of 65°F (adj.), and there is a demand for heating.
 2. When the OAT is 1°F (adj.) or more above the OAT heating set point of 65°F (adj.), heating is disabled.
 3. Low temperature protection: The supply air temperature sensor de-energizes the supply fan when temperatures below 38°F are sensed. All dampers (OA damper shall close/RA damper shall open) and hot water coil shall open to full coil flow when 38°F or below is sensed.
- K. **Smoke detection:** The unit shall shut down and generate an alarm upon receiving a smoke detector status.
- L. **A2L Mitigation:** The A2L mitigation controller shall be factory provided by the unit manufacturer. All functions of the A2L mitigation shall be provided by the unit manufacturer. When any of the unit's A2L sensors detect an A2L refrigerant leak or controller does not detect a sensor connection, the controller shall enable the supply fan, disable the compressors, and enable the A2L alarm. The ATC contractor shall receive the A2L alarm and display on operator workstation.
- M. **EF interface:** (E)EF-8 (Nurse) & (E)EF-12 (Admin office) The exhaust fan shall operate on building occupancy schedule with associated RTU-3 as follows:
1. Occupied mode: The exhaust fan shall start.
 2. Unoccupied mode: The fan shall stop.
 3. The BMS shall monitor the status of the exhaust fan (via CS) and generate an alarm if the fan fails to respond to a start/stop command.
- 1.5 **Beaumont Elementary School: RTU-4**
- A. **General:** The unit shall be provided with VFD drives for balancing purposes only. Zone temperature shall be controlled via a sequenced DAT reset. The unit controller shall use zone temperature to automatically select heating or cooling mode. Heating and cooling demand shall be calculated through independent heating and cooling PID outputs. These PIDs shall have individually adjustable interval, bias, and proportional, integral, and derivative parameters carefully tuned in each application for slow action to avoid hunting. The discharge air temperature shall first be reset depending on zone heating or cooling demand.

#26-016.01

230993 - 4

- B. **Occupied mode:** Supply fan shall run continuously with OA damper in its minimum position. The unit controller shall measure the supply air temperature and modulate the heating and cooling to maintain its heating and cooling space setpoint. The operator will be able to adjust the unit start/stop times using the operator's workstation. The BAS will monitor the status of the fan and generate an alarm if the fan fails to respond to a start/stop command.
- C. **Economizer mode:** BAS controller shall permit air-side economizer operation when outdoor air is less than 65°F but greater than 55°F. Economizer shall only operate when the room is in the cooling mode with outside relative humidity between 40% and 50%. When conditions for economizer cooling are satisfied, the outdoor air damper will modulate to maintain the supply air temperature to its target. On a rise in discharge air temperature above target, the outdoor air damper will modulate open. The reverse will occur on a fall in discharge air temperature below target.
- D. **Occupancy override:** The space temperature sensor will have a pushbutton that, when pressed during the unoccupied mode, will index the equipment to an occupied mode for a period of 2 hours (adjustable).
- E. **Unoccupied mode:** When the unit is shut down by either a stop command or system safety, the unit will be set as follows: supply fan will be off, outdoor air damper closed, return air damper open, and DX cooling off. Unit shall cycle if space temperature falls below the unoccupied setpoint in heating mode (adj.) and above unoccupied cooling mode (adj.) with outside air damper closed. The unit will de-energize when the space temperature is at least 4°F above the unoccupied heating setpoint. Unoccupied cooling is identical to the occupied operation except only one stage of cooling is the active stage.
- F. **D/X cooling:** The first stage of cooling will be energized if the space temperature is at least 1 degree above the space temperature cooling target. The first stage of cooling will be de-energized if the space temperature is at least 1 degree below the space temperature cooling target.
 - 1. The second stage of cooling will be energized by either of the following conditions:
 - 2. The space temperature is at least 0.5 degree above the space temperature cooling target and the first stage has been running for at least 10 minutes.
 - 3. The space temperature is at least 1 degree above the space temperature cooling target and the first stage has been running for at least 5 minutes.
 - 4. The second stage of cooling will be de-energized when the space temperature falls below its cooling target.
- G. **Dehumidification:** When humidity sensor goes above 55% RH (adj.), the BAS shall enable hot gas reheat and stage on both compressors and modulate hot gas reheat to maintain discharge air target. Logic must be set to make cooling the priority.
 - 1. Reheat is always controlled to the active discharge air temperature setpoint.
- H. **Morning warm-up:** On occupied days, the system will initiate morning warm-up cycle ½ hour before scheduled occupancy. The process will initiate supply fan and hot water heat to reach occupied setpoint without outdoor air damper open. Freeze protection will be active during this operation.
- I. **Hot water heating demand by (E)Duct mounted heating coils:** On a fall in zone temperature below the heating setpoint (adj.), the duct mounted heating coil control valve shall modulate to maintain the discharge target of 85°F (adj.). The discharge target shall be reset based on space temperature. On a rise in space temperature above setpoint, the heating coil control valve will modulate closed.
 - 1. Heating mode is available when the OAT is below the OAT heating upper limit of 65°F (adj.), and there is a demand for heating.
 - 2. When the OAT is 1°F (adj.) or more above the OAT heating set point of 65°F (adj.), heating is disabled.
 - 3. Low temperature protection: The supply air temperature sensor de-energizes the supply fan when temperatures below 38°F are sensed. All dampers (OA damper shall close/RA damper shall open) and hot water coil shall open to full coil flow when 38°F or below is sensed.

#26-016.01

230993 - 5

- J. **Smoke detection:** The unit shall shut down and generate an alarm upon receiving a return air smoke detector status.

1.6 Conestoga HS: AHU-9 & AHU-10

- A. **Single zone VAV:** The unit shall be configured for single zone VAV operation and shall be provided with VFD drives. Zone temperature shall be controlled via a sequenced DAT reset and fan speed control. The unit controller shall use zone temperature to automatically select heating or cooling mode. Heating and cooling demand shall be calculated through independent heating and cooling PID outputs. These PIDs shall have individually adjustable interval, bias, and proportional, integral, and derivative parameters carefully tuned in each application for slow action to avoid hunting of fan speed drives. The discharge air temperature shall first be reset depending on zone heating or cooling demand with fan operating at min airflow/speed. Then supply air fan will modulate through its min and max speed range to maintain the zone temperature setpoint as described below.
- B. **Occupied mode:** Supply fan shall run continuously with OA damper in its minimum position. The unit controller shall measure the supply air temperature and modulate the heating and cooling to maintain its heating and cooling space setpoint. The operator will be able to adjust the unit start/stop times using the operator's workstation. The BAS will monitor the status of the fan and generate an alarm if the fan fails to respond to a start/stop command. The outdoor air damper shall have proportional control which shall modulate the damper proportionally with fan speed to maintain minimum outside airflow throughout the range of fan airflow. AHU-9 shall be commanded on in occupied mode whenever AHU-11 fan is energized.
- C. **Economizer mode:** BAS controller shall permit air-side economizer operation when outdoor air is less than space temperature but greater than 50°F. Economizer shall only operate when the room is in the cooling mode with outside relative humidity between 40% and 50%. When conditions for economizer cooling are satisfied, the supply fan shall operate at 100% speed and outdoor air damper will modulate to maintain the discharge air temperature to its target. On a rise in discharge air temperature above target, the outdoor air damper will modulate open. The reverse will occur on a fall in discharge air temperature below target. The discharge target temperature shall be reset based on space temperature setpoint being maintained by increasing or decreasing discharge temperature. The unit controller shall reset the DAT from max 75°F (adj.) to min 50°F (adj.).
- D. **Unoccupied mode:** When the unit is shut down by either a stop command or system safety, the unit will be set as follows: supply fan will be off, outdoor air damper closed, return air damper open, and DX cooling off. Unit shall cycle if space temperature falls below the unoccupied setpoint in heating mode (adj.) and above unoccupied cooling mode (adj.) with outside air damper closed. The unit will de-energize when the space temperature is at least 4°F above the unoccupied heating setpoint.
- E. **Hot water heating demand:** When zone temperature drops below heating deadband setpoint, unit control shall be indexed to heating mode and cooling shall be disabled.
1. First stage – Heating DAT reset: The unit controller shall first reset DAT from min 70°F (adj.) to max 80°F (adj.) while supply air flow stays at min fan speed setpoint of 80% (adj.). The unit controller shall modulate the hot water valve to maintain its DAT setpoint.
 2. Second stage – Increase airflow: Upon continued zone temperature below setpoint, heating PID output increasing from 80–100% (adj.) shall increase supply airflow setpoint from min to max balanced VFD speed.
 3. Reverse shall occur as zone temperature rises above heating setpoint.
 4. Low temperature protection: A discharge air temperature sensor de-energizes the supply fan when temperatures below 38°F are sensed. All dampers (OA damper shall close/RA damper shall open) and hot water coil shall open to full coil flow when sensor detects 38°F or below.

#26-016.01

230993 - 6

- F. **Smoke detection:** The unit shall shut down and generate an alarm upon receiving a smoke detector status.
- G. **(E)EF-57 & (E)EF-68 gym exhaust integration:** Exhaust fans shall maintain existing sequence of operation. Exhaust fans shall be enabled whenever associated AHU-9 & 10 are enabled in economizer mode. One fan shall start when system is commanded on. The VFD shall start at minimum speed. The BMS shall monitor the space pressure. When building pressure increases above a pressure setpoint of -0.01" W.C. (adj.), the VFD speed shall increase up to maximum 100% (adj.) speed to maintain pressure setpoint. If 1st fan is operating above 80% speed, then start second fan.

1.7 Conestoga HS: AHU-11

- A. **Occupied mode:** The unit supply fan will run continuously at constant volume with OA damper in its minimum position in the occupied mode. Fan speed shall be for balancing only. Associated AHU-9 shall run in occupied mode whenever AHU-11 fan is operational.
- B. **Unoccupied mode:** When the unit is shut down by either a stop command or system safety, the unit will be set as follows: supply fan will be off, outdoor air damper closed, return air damper open, and heating coil valve closed unless outdoor air temperature falls below 45°F (adj.), then the valve will be fully open to the coil. Unit shall cycle if space temperature falls below the unoccupied setpoint (adj.) with outside air damper open to same minimum position as occupied mode. The unit will de-energize when the space temperature is at least 2°F above the unoccupied heating setpoint.
- C. **Space temperature adjustment:** The space temperature sensor will have an adjustment capability that will allow the space temperature setpoint to be adjusted $\pm 2^{\circ}\text{F}$.
- D. **Hot water coil control valve:** On a fall in discharge air temperature below the heating setpoint (adj.), the hot water coil control valve shall modulate to maintain the discharge target. The discharge target shall be reset up to 85°F (adj.) based on space temperature. On a rise in space temperature, the heating coil control valve will modulate closed. On a rise in discharge air temperature above the cooling setpoint (adj.), the hot water coil control valve shall modulate to maintain the discharge target. The discharge target shall be reset down to 70°F (adj.) based on space temperature.
- E. **Morning warm-up:** On occupied days, the system will initiate morning warm-up cycle ½ hour before scheduled occupancy. The process will initiate supply fan and heating coil valve (open to coil) to reach occupied setpoint with outdoor air damper in minimum position. Freeze protection will be active during this operation.
- F. **Economizer mode:** BAS controller shall permit air-side economizer operation when outdoor air is less than 65°F but greater than 55°F. Economizer shall only operate when the room is in the cooling mode with outside relative humidity between 40% and 50%. When conditions for economizer cooling are satisfied, the outdoor air damper will fully open.
- G. **Safeties:**
 - 1. Below an outside air temperature of 40°F (adj.), the hot water valve shall have a minimum position of 25% (adj.) regardless of operating mode for freeze protection.
 - 2. Manual reset dual-pole hard-wired freeze protection thermostat (38°F adj.) located on the discharge air side of the heating coil shall open the heating coil valve, de-energize the supply fan, close the outdoor air damper, and generate an alarm to the operator workstation. The BAS will monitor the discharge air temperature and shut down the unit and generate an alarm if it falls below 40°F (adj.). The shutdown will require a manual reset at the operator workstation.
 - 3. Smoke detection: The unit shall shut down and generate an alarm upon receiving a return air smoke detector status.

#26-016.01

230993 - 7

- H. **EF interface:** Upon system enabled in either occupied, warm-up, or unoccupied modes, associated exhaust fan EF-5 shall be enabled. Mount a current sensor on the fan motor leads to prove operation.

1.8 Conestoga HS: EF-27-2

- A. Fan shall maintain existing sequence of operation utilizing existing kitchen hood controls. Adjustable fan speed output shall be for balancing purposes only. Mount a current sensor on the fan motor leads to prove operation.

1.9 New Eagle ES: RTU-2E & HC-2E

- A. **Single zone VAV:** The unit shall be configured for single zone VAV operation and shall be provided with VFD drives. Zone temperature shall be controlled via a sequenced DAT reset and fan speed control. The unit controller shall use zone temperature to automatically select heating or cooling mode. Heating and cooling demand shall be calculated through independent heating and cooling PID outputs. These PIDs shall have individually adjustable interval, bias, and proportional, integral, and derivative parameters carefully tuned in each application for slow action to avoid hunting of fan speed drives. The discharge air temperature shall first be reset depending on zone heating or cooling demand with fan operating at min airflow/speed. Then supply air fan will modulate through its min and max speed range to maintain the zone temperature setpoint as described below.
- B. **Occupied mode:** Supply fan shall run continuously with OA damper in its minimum position. The unit controller shall measure the supply air temperature and modulate the heating and cooling to maintain its heating and cooling space setpoint. The operator will be able to adjust the unit start/stop times using the operator's workstation. The BAS will monitor the status of the fan and generate an alarm if the fan fails to respond to a start/stop command. The outdoor air damper shall have proportional control which shall modulate the damper proportionally with fan speed to maintain minimum outside airflow throughout the range of fan airflow.
- C. **Economizer mode:** BAS controller shall permit air-side economizer operation when outdoor air is less than 65°F but greater than 55°F. Economizer shall only operate when the room is in the cooling mode with outside relative humidity between 40% and 50%. When conditions for economizer cooling are satisfied, the outdoor air damper will modulate to maintain the discharge air temperature to its target. On a rise in discharge air temperature above target, the outdoor air damper will modulate open. The reverse will occur on a fall in discharge air temperature below target. Whenever the economizer is open 90% (adj.) or higher, economizer exhaust fan **EF-5 shall be enabled**. The BMS shall monitor the status of the exhaust fan (via CS) and generate an alarm if the fan fails to respond to a start/stop command.
- D. **Occupancy override:** The space temperature sensor will have a pushbutton that, when pressed during the unoccupied mode, will index the equipment to an occupied mode for a period of 2 hours (adjustable).
- E. **Unoccupied mode:** When the unit is shut down by either a stop command or system safety, the unit will be set as follows: supply fan will be off, outdoor air damper closed, return air damper open, and DX cooling off. Unit shall cycle if space temperature falls below the unoccupied setpoint in heating mode (adj.) and above unoccupied cooling mode (adj.) with outside air damper closed. The unit will de-energize when the space temperature is at least 4°F above the unoccupied heating setpoint. Unoccupied cooling is identical to the occupied operation except only one stage of cooling is the active stage.
- F. **DX cooling:** On a rise in average space temperature above the average cooling setpoint (adj.), the first stage of cooling shall be activated. The unit controller shall modulate the compressor to maintain the unit discharge target temperature. The discharge target temperature shall be reset based on space temperature setpoint being maintained by increasing or decreasing discharge temperature. Modulation of cooling

#26-016.01

230993 - 8

shall be configured subject to user-adjustable minimum run times, minimum off times, modulating up, and modulating down delays.

1. First stage – Cooling DAT reset: The unit controller shall first reset the DAT from max 70°F (adj.) to min 55°F (adj.) while supply air flow stays at min fan speed setpoint of 60% (adj.). The unit controller shall modulate the digital compressor to maintain the DAT setpoint.
 2. Second stage – Increase airflow: Upon continued zone temperature above setpoint (cooling PID output increasing from 60–100%), increase supply airflow setpoint from min to max balanced VFD speed setpoint.
 3. Reverse shall occur as zone temperature drops below cooling setpoint.
 4. The digital compressor continues to modulate during the entire cooling operation.
 5. If the economizer is enabled, it will function as the first stage of cooling.
- G. **Dehumidification:** When space humidity sensor goes above 55% RH (adj.), the supply fan shall maintain a constant 60% (adj.) speed and the BAS shall enable hot gas reheat and modulate digital compressor to maintain the suction pressure setpoint (adj.) and modulate hot gas reheat to maintain discharge air target. Logic must be set to make cooling or dehumidification the priority.
1. Once in dehumidification, the unit will maintain the evaporator coil suction temperature at the coil suction temperature setpoint by modulating the digital compressor (1.5–5.0 VDC operation).
 2. To stage down the extra compressors, the evaporator coil suction temperature needs to be below the evaporator coil suction temperature setpoint and the digital compressor needs to be at 0% for a period of time equal to the staging down delay.
 3. Reheat is always controlled to the active supply air temperature setpoint.
 4. Coil suction temperature setpoint reset: During dehumidification, the system will automatically reset the coil suction temperature setpoint within a $\pm 5^\circ$ range based on the space or return air humidity sensor condition changing $\pm 5\%$ from the humidity setpoint.
- H. **Morning warm-up:** On occupied days, the system will initiate morning warm-up cycle $\frac{1}{2}$ hour before scheduled occupancy. The process will initiate supply fan and hot water heat to reach occupied setpoint without outdoor air damper open. Freeze protection will be active during this operation.
- I. **Occupied heating mode (HC-2E):** When zone temperature drops below heating deadband setpoint, unit control shall be indexed to heating mode and cooling shall be disabled.
1. First stage – Heating DAT reset: The unit controller shall first reset DAT from min 70°F (adj.) to max 85°F (adj.) while supply air flow stays at min fan speed setpoint of 60% (adj.). The unit controller shall modulate the reheat valve to maintain its DAT setpoint.
 2. Second stage – Increase airflow: Upon continued zone temperature below setpoint, heating PID output increasing from 60–100% shall increase supply airflow setpoint from min to max balanced VFD speed.
 3. Reverse shall occur as zone temperature rises above heating setpoint.
 4. Heating mode is available when the OAT is below the OAT heating upper limit of 65°F (adj.), and there is a demand for heating.
 5. Low temperature protection: A low temperature detector directly after the heating coil de-energizes the supply fan when temperatures below 38°F are sensed. All dampers (OA damper shall close/RA damper shall open) and hot water coil shall open to full coil flow when freeze stat senses 38°F.
- J. **Smoke detection:** The unit shall shut down and generate an alarm upon receiving a return air smoke detector status.
- K. **A2L mitigation controller:** The A2L mitigation controller shall be factory provided by the unit manufacturer. All functions of the A2L mitigation shall be provided by the unit manufacturer. When any of the unit's A2L sensors detect an A2L refrigerant leak or the controller does not detect a sensor connection, the controller shall enable the supply fan, disable the compressors, and enable the A2L alarm. The ATC contractor shall receive the A2L alarm and display it on the operator workstation.

#26-016.01

230993 - 9

1.10 Valley Forge Middle School (HV-1):

- A. **Occupied mode:** The unit supply fan will run continuously at constant volume in the occupied mode. Fan speed shall be for balancing only.
- B. **Unoccupied mode:** When the unit is shut down by either a stop command or system safety, the unit will be set as follows: supply fan will be off, outdoor air damper closed, return air damper open, and heating coil valve closed unless outdoor air temperature falls below 45°F (adj.), then the valve will be fully open to the coil. Unit shall cycle if space temperature falls below the unoccupied setpoint (adj.) with outside air damper closed. The unit will de-energize when the space temperature is at least 4°F above the unoccupied heating setpoint.
- C. **Space temperature adjustment:** The space temperature sensor will have an adjustment capability that will allow the space temperature setpoint to be adjusted $\pm 2^{\circ}\text{F}$.
- D. **Hot water coil control valve:** On a fall in discharge air temperature below the heating setpoint (adj.), the hot water coil control valve shall modulate to maintain the discharge target. The discharge target shall be reset up to 85°F (adj.) based on space temperature. On a rise in space temperature, the heating coil control valve will modulate closed. On a rise in discharge air temperature above the cooling setpoint (adj.), the hot water coil control valve shall modulate to maintain the discharge target. The discharge target shall be reset down to 70°F (adj.) based on space temperature.
- E. **O/A damper:** The damper shall open to minimum position in occupied mode and close in unoccupied mode.
- F. **Morning warm-up:** On occupied days, the system will initiate morning warm-up cycle ½ hour before scheduled occupancy. The process will initiate supply fan and heating coil valve (open to coil) to reach occupied setpoint without outdoor air damper open. Freeze protection will be active during this operation.
- G. **Economizer mode:** BAS controller shall permit air-side economizer operation when outdoor air is less than 65°F but greater than 55°F. Economizer shall only operate when the room is in the cooling mode with outside relative humidity between 40% and 50%. When conditions for economizer cooling are satisfied, the outdoor air damper will fully open.
- H. **Safeties:**
 - 1. Below an outside air temperature of 40°F (adj.), the hot water valve shall have a minimum position of 25% (adj.) regardless of operating mode for freeze protection.
 - 2. Manual reset dual-pole hard-wired freeze protection thermostat (38°F adj.) located on the discharge air side of the heating coil shall open the heating coil valve, de-energize the supply fan, close the outdoor air damper, and generate an alarm to the operator workstation. The BAS will monitor the discharge air temperature and shut down the unit and generate an alarm if it falls below 40°F (adj.). The shutdown will require a manual reset at the operator workstation.
 - 3. Smoke detection: The unit shall shut down and generate an alarm upon receiving a return air smoke detector status.
- I. **(E)EF-27 & (E)EF-29 EF interface:** Upon system enabled in occupied mode, associated exhaust fan(s) shall be enabled. Mount a current sensor on the fan motor leads to prove operation.

#26-016.01

230993 - 10

1.11 Valley Forge Middle School (HP-1/CC-1):

- A. **General:** Ductless split system heat pump and AC unit shall be operated by manufacturer controls. The ATC contractor shall provide a temperature sensor to monitor the temperature in the room and unit scheduling function. An alarm shall be generated if the temperature rises above a user-definable setpoint.
- B. **OA damper:** Provide unit scheduling function through the central controller for control of OA damper.
 - 1. Occupied mode: When the AHU zone is in occupied mode and the AHU fan is running, the outside air damper shall open.
 - 2. Unoccupied mode: The outside air damper shall close.
- C. **Display/interface requirements:**
 - 1. Room #
 - 2. Zone temperature
 - 3. Unit operation (mount a current sensor on the compressor motor leads to prove operation)

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

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 pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Hot-water heating piping.
 - 2. Dual temperature Piping
 - 3. Condensate-drain piping.
 - 4. Blowdown-drain piping.
 - 5. Air-vent piping.
 - 6. Safety-valve-inlet and -outlet piping.
- B. Related Sections include the following:
 - 1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
 - 2. Division 23 Section "Common Work Results for HVAC" for welding requirements.
 - 3. Division 23 Section "Underground Hydronic 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. Hot-Water Heating Piping: 125 psig at 200 deg F.
 - 2. Condensate-Drain Piping: 150 deg F.
 - 3. Air-Vent Piping: 200 deg F.
 - 4. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

#26-016.01

232113 – 2

1.5 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Plastic pipe and fittings with solvent cement.
 - 2. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 3. Air control devices.
 - 4. Hydronic specialties.
- 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.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.
- G. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.6 QUALITY ASSURANCE

- A. 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 and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

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.

#26-016.01

232113 – 3

- C. Wrought-Copper Fittings: ASME B16.22.
- D. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.
- H. Pre-manufactured tees and reducer tees for standard pipe sizes: 2-1/2", 3", 4", 6", 8", 10", 12".
- I. O-Lets (Weldolets and Threadolets) will only be allowed where the tee or reducer tee size is not a standard product or where the O-Let size is 1-1/4" or less.

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.
 - 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. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- E. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

#26-016.01

232113 – 4

2.4 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint or plain end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. 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. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.
 - 2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. 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.; a division of Watts Water Technologies, Inc.
 - 2. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric-Flange Kits:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 3. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

#26-016.01

232113 – 5

- a. Calpico, Inc.
 - b. Lochinvar Corporation.
- 2. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- G. Dielectric Nipples:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Perfection Corporation; a subsidiary of American Meter Company.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Victaulic Company of America.
 - 2. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain or threaded ends; and 300-psig minimum working pressure at 225 deg F.

2.5 VALVES

- A. Check, Ball, and Gate Valves: Comply with requirements specified in Division 23 Section "General – Duty Valves for Piping."
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Controls for HVAC."
- C. Bronze, Calibrated-Orifice, Balancing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - 2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 - 3. Ball: Brass or stainless steel.
 - 4. Plug: Resin.
 - 5. Seat: PTFE.
 - 6. End Connections: Threaded or socket.
 - 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 - 8. Handle Style: Lever, with memory stop to retain set position.
 - 9. CWP Rating: Minimum 125 psig.
 - 10. Maximum Operating Temperature: 250 deg F.
- D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - 2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
 - 3. Ball: Brass or stainless steel.
 - 4. Stem Seals: EPDM O-rings.

#26-016.01

232113 – 6

5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig.
11. Maximum Operating Temperature: 250 deg F.

2.6 AIR CONTROL DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
4. Taco.

B. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

C. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/4.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 240 deg F.

2.7 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 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.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot-water heating, chilled-water and dual temperature piping, aboveground, NPS 2 and smaller, shall be the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- B. Hot-water heating, chilled-water and dual temperature piping, aboveground, NPS 2-1/2 and larger, shall be one of the following:
 - 1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints. All welding is to be done on site.
 - 2. No O-Lets will be allowed on piping unless 1-1/4" or smaller in diameter.
 - 3. Any O-Lets shall be drilled, not torch cut. All drilled openings shall be cleaned up and smooth prior to any welding of O-Lets. All slag shall be cleaned and removed from the welded O-Let.
 - 4. Full penetration welds are required for each O-Let connection.
 - 5. Full penetration welds are required for all pre-manufactured tees, reducer tees and all welds.
- C. 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.
- D. Air-Vent Piping:
 - 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
 - 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.
- E. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.2 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and

#26-016.01

232113 – 8

pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

- F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.3 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using 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.
- P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

#26-016.01

232113 - 9

- S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."
- U. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet 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. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 - 6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 - 7. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.
 - 8. NPS 6: Maximum span, 12 feet; minimum rod size, 1/2 inch.
- D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 - 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 - 3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
- E. 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.
- F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

#26-016.01

232113 – 10

3.5 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. 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. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. 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.

3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.
- C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- D. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

#26-016.01

232113 – 11

- E. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above the floor. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.
- F. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
 - 1. Install tank fittings that are shipped loose.
 - 2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.
- G. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.8 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 - 3. Isolate expansion tanks and determine that hydronic system is full of water.
 - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve,

#26-016.01

232113 – 12

or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant: R-454B & 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.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

#26-016.01

232300 - 2

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.

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.

#26-016.01

232300 - 3

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.
 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.

#26-016.01

232300 - 4

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.
- 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.

#26-016.01

232300 - 5

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-454B: Hydrofluorocarbon/hydrofluoroolefin
- D. ASHRAE 34, R-32: Difluoromethane

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:

#26-016.01

232300 - 6

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.
 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.

#26-016.01

232300 - 7

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.
- 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.

#26-016.01

232300 - 8

- 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.
 - 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.

#26-016.01

232300 - 9

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.
 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

#26-016.01

233113 - 1

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. Factory-built double wall grease duct.
 - 4. Sheet metal materials.
 - 5. Duct liner.
 - 6. Sealants and gaskets.
 - 7. Hangers and supports.

- B. Related Sections:

- 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.

#26-016.01

233113 - 2

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, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

#26-016.01

233113 - 3

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."
 - 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-

#26-016.01

233113 - 4

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 FACTORY BUILT DOUBLE WALL GREASE DUCT

- A. Furnish double wall, factory built grease duct for use with Type I kitchen hoods, which conforms to the requirements of NFPA-96. Products shall be ETL listed to UL-1978 and UL-2221 for venting air and grease vapors from commercial cooking operation.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Captiveaire.
 - b. Engineer approved equal.
- B. Models 3Z is used for grease duct applications when installed in accordance with these instructions and National Fire Protection Association "NFPA 96"; Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations. Double wall grease ducts are listed for a continuous internal temperature of 500 degrees F and intermittent temperatures of 2000 degrees F.
- C. The duct sections shall be constructed of an inner duct wall and an outer wall with insulation in between. The inner duct wall shall be constructed of 0.036 inch-thick, 430 type stainless steel and be available in diameters 5" through 36". The outer wall shall be constructed of stainless steel at a minimum of 0.024 inch-thickness. The duct shall include layers of Super Wool 607 Plus, Insulfrax Elite Blanket insulation, or Unifrax S16 Bulk Fiber insulation between the inner and outer wall. Grease duct joints shall be held together by means of formed V clamps and sealed with 3M Fire Barrier 2000+. The duct wall assembly shall be tested and listed at zero-inch clearance, according to classifications.

2.4 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.

#26-016.01

233113 - 5

- 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.

2.5 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.
 - 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.

#26-016.01

233113 - 6

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. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.6 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.

#26-016.01

233113 - 7

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.
 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.

2.7 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

#26-016.01

233113 - 8

loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, 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.

#26-016.01

233113 - 9

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD
EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- 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.
 - 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.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches 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.

#26-016.01

233113 - 10

- 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.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have 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.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Test the following systems:
 - a. Ducts with a Pressure Class Higher Than 3-Inch wg: 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:

#26-016.01

233113 - 11

1. Visually inspect duct system to ensure that no visible contaminants are present.
 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
 - D. Duct system will be considered defective if it does not pass tests and inspections.
 - E. Prepare test and inspection reports.
- 3.9 START UP
- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."
- 3.10 DUCT SCHEDULE
- A. Supply Ducts:
 1. Ducts Connected to AHU & 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 AHUs, 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:

#26-016.01

233113 - 12

- 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.
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. Round Ducts Connected to Type I Commercial Kitchen Hoods: Provide Double-wall factory welded grease duct system Captive Aire Model 3Z or engineer approved equal. Comply with NFPA 96, UL-1978 and UL-2221.
 - a. The inner duct wall shall be constructed of 0.036 inch thick, 430 type stainless steel.
 - b. The outer wall shall be constructed of stainless steel at a minimum of 0.024 inch thickness.
 - c. Grease duct joints shall be held together by means of formed vee clamps and sealed with 3M Fire Barrier 2000+.
 - d. The duct shall include layers of Super Wool 607 Plus insulation between the inner and outer wall as required to achieve specified clearance to combustibles.
 - e. The duct wall assembly shall be tested and listed as an alternate to 2-Hr. fire resistive shaft enclosures with a minimum zero inch clearance, according to classifications.
4. 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.

#26-016.01

233113 - 13

- 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 20 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, AHU 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. Liner type and thickness unless otherwise noted:
 - a. Supply Air Ducts: Fibrous glass, Type I, 1 inch thick.
 - b. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.
 - 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.

#26-016.01

233113 - 14

- 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.
 - 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

PART 1 - GENERAL

1.1 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.
 - 2. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.

#26-016.01

233116 - 2

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.
 1. Warranty Period: 20 years from date of Substantial Completion.

#26-016.01

233116 - 3

PART 2 - PRODUCTS

2.1 PHENOLIC-FOAM DUCTS AND FITTINGS

A. Manufacturers:

1. Basis of Design: Techna-Duc System by PTM Manufacturing, LLC 800-455-1402.
2. ThermaDuct LLC
3. Engineer approved equal.

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: ≤ 25
 - b. Smoke Developed: ≤ 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/m³).
 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.

#26-016.01

233116 - 4

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. Turning 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. 1/2" or 3/4" 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.

#26-016.01

233116 - 5

2. 4-Bolt Coupling System
 - 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 – Techna-Duc® 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 color white.

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.
 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.

#26-016.01

233116 - 6

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.
- 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.

#26-016.01

233116 - 7

- 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.
- 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."

#26-016.01

233116 - 8

- 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.
- 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."

#26-016.01

233116 - 9

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

PART 1 - GENERAL

1.1 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. Flange connectors.
4. Turning vanes.
5. Duct-mounted access doors.
6. Flexible connectors.
7. Flexible ducts.
8. Duct accessory hardware.

B. Related Sections:

1. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
2. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

1.3 SUBMITTALS

- A. 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:

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.

#26-016.01

233300 - 2

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.

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.

#26-016.01

233300 - 3

- 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:
 - 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.

#26-016.01

233300 - 4

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.
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.

#26-016.01

233300 - 5

- 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.

2.4 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.

#26-016.01

233300 - 6

2.5 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.

2.6 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.

#26-016.01

233300 - 7

- d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.7 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.

2.8 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.

#26-016.01

233300 - 8

- 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.

2.9 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.
 - 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.

2.10 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.

#26-016.01

233300 - 9

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.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.

#26-016.01

233300 - 10

- 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.

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:
 - 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.

#26-016.01

233300 - 11

5. Operate remote damper operators to verify full range of movement of operator and damper.

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. Centrifugal roof ventilators.
 - 2. Kitchen Utility set fans.
 - 3. Variable frequency controllers

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.
 - 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

#26-016.01

233423 - 2

- 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.
- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

#26-016.01

233423 - 3

- 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.

2.2 KITCHEN UTILITY SET FANS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings or a comparable product by one of the following:
 - 1. Captiveaire
 - 2. Loren Cook Company
- B. Description: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.
- C. Certifications: All models shall be ETL Listed and comply with UL705 (electrical), UL762, and ULC-S645 Standards and CSA Std C22.2, No 113. Fan shall bear the AMCA certified ratings seal for sound and air performance.
- D. Housing: The fan shall be constructed of aluminized and galvanized steel. Fan scroll shall be continuously sealed with a listed intumescent to prevent grease leakage. The fan scroll shall be tack welded and have a 2" fully welded drain to prevent grease leakage and blockage of the drain.
- E. Fan Wheels: The fan wheel shall be centrifugal backward inclined and non-overloading. Wheels shall be balanced in two planes and done in accordance with AMCA standard 204-96, Balance Quality and Vibration Levels for Fans. The wheel blades shall be aerodynamically designed to minimize turbulence, increase efficiency and reduce noise. The wheel shall be heavy gauge welded aluminum. In the event that balancing weights are required they shall be riveted or welded to the blades or wheel. The wheel inlet shall overlap the fan inlet for maximum performance and efficiency. The wheel shall be firmly attached to the motor shaft with set screws.
- F. Motors: Meet or exceed EISA (Energy Independence and Security Act) efficiencies. Motors to be NEMA Premium efficient T-frame, 1800 RPM, Open Drip Proof (ODP) with a 1.15 service factor. Provide motor inverter duty with Class F insulation.
- G. Drives: Drives shall be cast type, precision machined and keyed and secured attached to the fan and motor shafts. Drives shall be sized for a minimum of 150% of the installed motor horsepower. Fan operating speed shall be factory set using adjustable pitch motor pulleys; motors over 2 HP will come standard with double groove pulleys.
- H. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

#26-016.01

233423 - 4

- I. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9, L₅₀ of 200,000 hours.
- J. Grease Spout: The 2" grease drain is fully welded in the discharge scroll, a removable grease trough is attached to the scroll to collect grease.
- K. Accessories:
 - 1. Inlet and Outlet: Flanged.
 - 2. Companion Flanges: Rolled flanges for duct connections of same material as housing.
 - 3. Access Door: Gasketed door in scroll with latch-type handles.
 - 4. Weather Hoods: Weather resistant with stamped vents over motor and drive compartment.
 - 5. Variable-Frequency Drive: Solid-state control to reduce speed from 100 to less than 50 percent.
 - 6. Inlet Guards – Constructed of expanded metal mounted in a steel frame to provide protection for fan inlet. Guard shall be removable for inspection.
 - 7. Spring Isolators.
 - 8. Utility Set Grease Cup
 - 9. 24" Discharge extension
 - 10. Support Rails

2.3 VARIABLE FREQUENCY CONTROLLERS

- A. Description: PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase induction motor by adjusting output voltage and frequency.
 - 1. Provide unit suitable for operation of standard-efficiency motor as defined by NEMA MG 1.
- B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- C. Furnish and install ABB ACH 550 variable frequency controller or approved equal.
- D. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range
- E. All VFDs shall have the following standard features:
 - 1. All circuit boards shall be coated to protect against corrosion.
 - 2. All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.
 - 3. The keypad shall include Hand-Off-Auto selections and manual speed control. The drive shall incorporate "bumpless transfer" of speed reference when switching between "Hand" and "Auto" modes. There shall be fault reset and "Help" buttons on the keypad. The Help button shall include "on-line" assistance for programming and troubleshooting.
 - 4. There shall be a built-in time clock in the VFD keypad. The clock shall have a battery backup with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. VFD programming shall be held in non-volatile memory and is not dependent on battery power
 - 5. The VFD's shall utilize pre-programmed application macros specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time. The VFD shall have two user macros to allow the end-user to create and save custom settings.
 - 6. The VFD shall have cooling fans that are designed for easy replacement. The fans shall be designed for replacement without requiring removing the VFD from the wall or removal of circuit

#26-016.01

233423 - 5

- boards. The VFD cooling fans shall operate only when required, based on the temperature of and run command to the drive. VFD protection shall be based on thermal sensing and not cooling fan operation.
7. The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set point without tripping or component damage (flying start).
 8. The VFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.
 9. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds every minute. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430.250 for 4-pole motors.
 10. VFDs through 200 HP shall have internal swinging (non-linear) chokes providing impedance equivalent to 5% to reduce the harmonics to the power line. Swinging choke shall be required resulting in superior partial load harmonic reduction. Linear chokes are not acceptable. 5% impedance may be from dual (positive and negative DC bus) chokes, or 5% swinging AC line chokes. VFD's with only one DC choke shall add an AC line choke.
 11. The input current rating of the VFD shall not be greater than the output current rating. VFD's with higher input current ratings require the upstream wiring, protection devices, and source transformers to be oversized per NEC 430.122. Input and output current ratings must be shown on the VFD nameplate.
 12. The VFD shall include a coordinated AC transient surge protection system consisting of 4 MOVs (phase to phase and phase to ground), a capacitor clamp, 1600 PIV Diode Bridge and internal chokes. The MOV's shall have a minimum 125 joule rating per phase across the diode bridge. VFDs that do not include coordinated AC transient surge protection shall include an external TVSS (Transient Voltage Surge Suppressor).
 13. The VFD shall provide a programmable loss-of-load (broken belt / broken coupling) Form-C relay output. The drive shall be programmable to signal the loss-of-load condition via a keypad warning, Form-C relay output, and / or over the serial communications bus. The loss-of-load condition sensing algorithm shall include a programmable time delay that will allow for motor acceleration from zero speed without signaling a false loss-of-load condition.
 14. The VFD shall include multiple "two zone" PID algorithms that allow the VFD to maintain PID control from two separate feedback signals (4-20mA, 0-10V, and / or serial communications). The two zone control PID algorithm will control motor speed based on a minimum, maximum, or average of the two feedback signals. All of the VFD PID controllers shall include the ability for "two zone" control.
 15. If the input reference is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, Form-C relay output and / or over the serial communication bus.
 16. The VFD shall have programmable "Sleep" and "Wake up" functions to allow the drive to be started and stopped from the level of a process feedback signal.
- F. All VFDs to have the following adjustments:
1. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed. The lockout range must be fully adjustable, from 0 to full speed.
 2. Two (2) PID Set point controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed-loop control. The VFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID set point shall be adjustable from the VFD keypad, analog inputs, or over the communications bus. There shall be two independent parameter sets for the PID controller and the capability to switch between the parameter sets via a digital input, serial

#26-016.01

233423 - 6

- communications or from the keypad. The independent parameter sets are typically used for night setback, switching between summer and winter set points, etc.
3. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain the set point of an independent process (i.e. valves, dampers, etc.). All set points, process variables, etc. to be accessible from the serial communication network.
 4. Two (2) programmable analog inputs shall accept current or voltage signals.
 5. Two (2) programmable analog outputs (0-20ma or 4-20 ma). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, Active Feedback, and other data.
 6. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices. All digital inputs shall be programmable to initiate upon an application or removal of 24VDC.
 7. Three (3) programmable, digital Form-C relay outputs. The relay outputs shall include programmable on and off delay times and adjustable hysteresis. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating of 2 amps RMS. Outputs shall be true Form-C type contacts; open collector outputs are not acceptable. Drives that have only two (2) relay outputs must provide an option card that provides additional relay outputs.
 8. Run permissive circuit - There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, input contact closure, time-clock control, or serial communications), the VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD digital input and allows VFD motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop and the damper shall be commanded to close. The keypad shall display "start enable 1 (or 2) missing". The safety input status shall also be transmitted over the serial communications bus.
 9. The VFD control shall include a programmable time delay for VFD start and a keypad indication that this time delay is active. A Form C relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates. The time delay shall be field programmable from 0 – 120 seconds. Start delay shall be active regardless of the start command source (keypad command, input contact closure, time-clock control, or serial communications), and when switching from drive to bypass.
 10. Seven (7) programmable preset speeds.
 11. Two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps.
 12. The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise. The VFD shall have selectable software for optimization of motor noise, energy consumption, and motor speed control.
 13. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows higher carrier frequency settings without derating the VFD.
 14. The VFD shall include password protection against parameter changes.
- G. The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable). All VFD faults shall be displayed in English words. The keypad shall include a minimum of 14 assistants including:
1. Start-up assistant
 2. Parameter assistants
 - a. PID assistant
 - b. Reference assistant
 - c. I/O assistant
 - d. Serial communications assistant
 - e. Option module assistant
 - f. Panel display assistant

#26-016.01

233423 - 7

- g. Low noise set-up assistant
 - h. Maintenance assistant
 - i. Troubleshooting assistant
 - j. Drive optimizer assistants
 - H. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):
 - 1. Output Frequency
 - 2. Motor Speed (RPM, %, or Engineering units)
 - 3. Motor Current
 - 4. Motor Torque
 - 5. Motor Power (kW)
 - 6. DC Bus Voltage
 - 7. Output Voltage
 - I. Serial Communications
 - 1. The VFD shall have an EIA-485 port as standard. The standard protocols shall be Modbus, Johnson Controls N2, Siemens Building Technologies FLN, and BACnet. Use of non-certified protocols is not allowed.
 - 2. Serial communication capabilities shall include, but not be limited to; run-stop controls, speed set adjustment, and lock and unlock the keypad. The drive shall have the capability of allowing the BAS to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The BAS shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible.
 - 3. The VFD shall allow the BAS to control the drive and bypass digital and analog outputs via the serial interface. This control shall be independent of any VFD function. The analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive and bypass' digital (Form-C relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive and bypass' digital inputs shall be capable of being monitored by the BAS system. This allows for remote monitoring of which (of up to 4) safeties are open.
- 2.4 VFD ACCESSORIES
- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
 - B. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.
 - C. Control Relays: Auxiliary and adjustable time-delay relays.
 - D. Current-Sensing, Phase-Failure Relays for Bypass Controller: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

#26-016.01

233423 - 8

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.
 - 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.

#26-016.01

233423 - 9

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

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fixed and adjustable face grilles.
- 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.

PART 2 - PRODUCTS

2.1 REGISTERS AND GRILLES

- A. Adjustable Bar Grille, Tag-C:

#26-016.01

233713 - 2

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, 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.

B. 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, in color chosen by the architect.
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.

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.

2.2 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."

#26-016.01

233713 - 3

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

PART 1 - GENERAL

1.1 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. Ducted air handling units and accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of air handling unit indicated.
- E. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which air handling units will be attached.
 - 3. Method of attaching hangers to building structure.
 - 4. Size and location of initial access modules for acoustical tile.
 - 5. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - 6. Perimeter moldings.
- F. Field quality-control reports.

#26-016.01

237313 - 2

- G. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air handling units to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.

1.5 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 COORDINATION

- A. Coordinate layout and installation of air handling units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate size and location of wall sleeves for outdoor-air intake.

1.7 WARRANTY

- A. AHU 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 SYSTEM DESCRIPTION

- 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. Factory-packaged and -tested units rated according to AHRI 440, ASHRAE 33, and UL 1995.

#26-016.01

237313 – 3

2.2 AIR HANDLING UNITS

A. Manufacturers:

1. Aeon
2. AdaptivAir.

B. Description:

1. Factory-packaged and -tested units rated according to UL 1995/CSA C22.2 No. 236.
2. Direct Drive Air Handling Units, 4-pipe. Horizontal cabinets.

C. Configuration

1. Complete with galvanized cabinet, coils, blower section, sloped stainless steel drain pan, insulation, with 2- or 4-pipe unit configuration. Heating and cooling to be hydronic.

D. Materials

1. General: Except as otherwise indicated shall be a standard by International Environmental Corporation.
2. Coils:
 - a. Copper tube, aluminum fin (copper fin), 1/2" staggered tube design, rated at 250 psig at 200°F, and leak tested at 300 psig.
 - b. Provide manual (automatic) air vent.
 - c. Provide end sheets and bottom coil baffles fabricated with galvanized (stainless) steel.

E. Blowers:

1. Statically and dynamically balanced, and of indicated capacity.
2. Provide centrifugal, forward curved wheel.
3. Bearings shall be ball bearing type (no sleeve bearings allowed), permanently lubricated and sealed for life.
4. Blower/motor assembly isolated from cabinet.

F. Motors:

1. Provide Electronically Commutated, single-phase, open drip proof, permanently lubricated ball bearing motor. Motor shall have integrated control module with overload and short circuit protection.. Control module is mounted in cabinet interior.
2. Motors shall be RPM controlled, UL recognized, or equivalent, continuous duty rated.
3. Factory wired to unit control box.
4. Motor protected with thermal overload.
5. Motor bearings shall be permanently lubricated.
6. Motor installed on same side as coil connections for ease of service.

G. Cabinets:

1. AHU-4 & 5: Fabricate from heavy gauge aluminum, double wall construction.
2. AHU-6, 7 & 8: Fabricate from heavy gauge galvanized steel, double wall construction.
3. Insulation to be 1" Closed Cell.
4. Furnish with access panels on both sides of unit, easily removable without tools.
5. Holes for through-hanger rods are located at top and bottom 4 corners of cabinet.
6. Double wall construction with 1" fiberglass insulation with solid or perforated inner liners.

H. Drain Pans:

1. Standard with Type 304 stainless steel.
2. Externally isolated with 2-part closed cell foam insulation.
3. Double-sloped toward outlets.
4. Inside is smooth for easy cleaning.

#26-016.01

237313 - 4

5. Furnished with primary 3/4" male NPT and "tell-tale" 1/2" male NPT secondary drain connections on same end with coil connections. Secondary drain connection must be capped by installer if not used.
 6. Drain pan is removable from cabinet from same end as coil connections for ease of cleaning.
- I. Filters:
1. Standard 2" pleated MERV 8 filters.
 2. Removable from either side or bottom of filter rack without tools.
- J. Control Schemes
1. Refer to DWG M400 series and Division 23 Section "Instrumentation and Control for HVAC" for additional unit control requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, to receive air handling units for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before air handling unit installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install air handling units level and plumb.
- B. Install air handling units to comply with NFPA 90A.
- C. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above finished floor.
- D. Install new filters in each air handling unit within two weeks after Substantial Completion.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
 1. Install piping adjacent to machine to allow service and maintenance.
 2. Install condensate trap of adequate depth to seal against fan pressure. Install cleanouts in piping at changes of direction.
- B. Connect supply-air and return-air ducts to air handling units with flexible duct connectors specified in Section 233300 "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

#26-016.01

237313 – 5

- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections:
 - 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.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.5 ADJUSTING

- A. Adjust initial temperature and humidity 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 air handling units.

END OF SECTION

#26-016.01

237433 - 1

PART 1 - GENERAL

1.1 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.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals.

#26-016.01

237433 - 2

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.

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 UL Standard 1995/CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.
 - 4. 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.

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, and unit terminal control strip.

#26-016.01

237433 - 3

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.
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, 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.

#26-016.01

237433 - 4

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. 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.

#26-016.01

237433 - 5

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 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.
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.

#26-016.01

237433 - 6

- 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. 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.

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:
 - 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.

#26-016.01

237433 - 7

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 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.
- 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.

#26-016.01

237433 - 8

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. Install separate devices furnished by manufacturer and not factory installed.
- E. 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. Drawings indicate the general arrangement of ducts.
 - 3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 233300 "Air Duct Accessories."
- C. 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.

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. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
 - a. High-limit heat exchanger.
 - b. Alarms.

#26-016.01

237433 - 9

4. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
 5. 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.
 6. 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.
 7. Inspect casing insulation for integrity, moisture content, and adhesion.
 8. Verify that clearances have been provided for servicing.
 9. Verify that controls are connected and operable.
 10. Verify that filters are installed.
 11. Clean coils and inspect for construction debris.
 12. Clean furnace flue and inspect for construction debris.
 13. Inspect operation of power vents.
 14. Inspect and adjust vibration isolators and seismic restraints.
 15. Verify bearing lubrication.
 16. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 17. Adjust fan belts to proper alignment and tension.
 18. Start unit.
 19. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
 20. Operate unit for run-in period.
 21. Calibrate controls.
 22. Adjust and inspect high-temperature limits.
 23. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
 24. Verify operational sequence of controls.
 25. 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.

#26-016.01

237433 - 10

- 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

PART 1 - GENERAL

1.1 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 ductless 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."

#26-016.01

238126 - 2

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.

#26-016.01

238126 - 3

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-32A.
- 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.
- 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."

#26-016.01

238126 - 4

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:

#26-016.01

238126 - 5

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

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 types of air coils that are not an integral part of air-handling units:

- 1. Hot-water coils.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each air coil. Include rated capacity and pressure drop for each air coil.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which coil location and ceiling-mounted access panels are shown and coordinated with each other.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 WATER COILS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Capital Coil & Air
 - 2. Direct Coil
 - 3. Nortek.
- B. Performance Ratings: Tested and rated according to ARI 410 and ASHRAE 33.

#26-016.01

238216 - 2

- C. Minimum Working-Pressure/Temperature Ratings: 200 psig, 220 deg F.
- D. Source Quality Control: Factory tested to 300 psig.
- E. Tubes: ASTM B 743 copper, minimum 0.02 inch thick.
- F. Fins: Aluminum, minimum 0.008 inch thick.
- G. Headers: Type L Copper with drain and air vent tapplings or Seamless copper tube with brazed joints, prime coated.
- H. Frames: Galvanized-steel channel frame, minimum 16 gauge for flanged mounting.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install coils level and plumb.
- B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- C. Straighten bent fins on air coils.
- D. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to coils to allow service and maintenance.
- C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Division 23 Section "Instrumentation and Controls," and other piping specialties are specified in Division 23 Section "Hydronic Piping."

#26-016.01

238216 - 3

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, operate electric coils to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

#26-016.01

260000 - 1

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 apply to this section.

1.2 WARRANTY FOR PROJECT

- 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.

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. BES – Beaumont Elementary School
- E. DES – Devon Elementary School
- F. HES – Hillside Elementary School
- G. NEES – Beaumont Elementary School
- H. VFES – Valley Forge Elementary School
- I. VFMS – Valley Forge Middle School
- J. TEMS – Tredfyffrin/Easttown Middle School
- K. CHS – Conestoga High School
- L. NOC – Network Operations Center

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 electrical work, as indicated on the drawings and described hereinafter. The

#26-016.01

260000 - 2

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 HVAC Renovations at Beaumont Elementary School, New Eagle Elementary School, Valley Forge Middle School, and Conestoga High School, in the Tredyffrin/Easttown School District (all scope listed below is base bid unless otherwise noted):

1. Construction Phasing and Sequencing:
 - a. Working hours and dates: Refer to the Division 0 and 1 specifications for all details and requirements.
 - b. Any and all power outages for normal electrical systems in the buildings shall occur Monday thru Friday and shall be requested in writing to the Owner a minimum of 14 days in advance.
 - c. Contractor shall include all required overtime in his bid; the Owner will not provide additional compensation to the Contractor for work performed outside of normal working hours in order to complete the project per schedule and per the required construction phasing and sequencing requirements.
2. Demolish electrical conduit, wiring and equipment as shown on the drawings, as required in these specifications and as required to accommodate the new and renovation construction activities and the required construction phasing to allow the Owner to occupy the building during construction. Remove wiring back to the respective source for all associated equipment indicated to be demolished and maintain the electrical circuit integrity as required for equipment to remain. Remove exposed conduit back to the respective source for all associated equipment indicated to be demolished – cut, cap and label conduits that are embedded in permanent walls and floors; provide cutting and patching of the same.
3. For detailed scope of work for each electrical system, refer to the respective Division 26 specification sections.
4. Relocate devices and wiring as shown on the plans.
5. Provide and install lighting equipment and controls, including digital controllers and programming of the controllers and wall switches.
6. Provide and install new panelboards and connect to existing feeders.
7. Provide and install retrofit breakers in existing panelboards and distribution panels. 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.
8. Provide and install new wiring devices and backboxes.
9. 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.
10. Provide patching, painting and sealing of all interior openings created by demolishing any equipment or conduit.
11. Adjust connections to electrical motors to insure proper rotation.
12. Provide and install wiring and final connections to all equipment in Mechanical specifications and drawings requiring electrical service.
13. Testing and balancing of Electrical system.
14. All necessary rigging.
15. Removal of trash and general clean-up.
16. All necessary permits, approvals, fees, etc.
17. Instruction to the Owner.
18. Cutting, patching and clean-up.
19. The contractor shall employ the services of the local Underwriters' Inspection Agency and pay for

#26-016.01

260000 - 3

all associated fees.

- B. It will be the responsibility of the Contractor to examine all Drawings (Architectural, Civil, Structural, Mechanical, and Electrical) 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.
- C. Coordination Between Mechanical and Electrical Contractors:
1. The Electrical Contractor shall:
 - a. Receive and set the motor starters as provide by the Mechanical Contractor.
 - 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.
 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. Provide all control wiring including 120V controls, 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.
 - g. 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.
 - h. Provide and installation roof curbs.
 3. 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.
- D. Coordination Between General and Electrical Contractors:

1. The Electrical Contractor shall:
 - a. Provide and install interior concrete housekeeping pads.
 - b. Provide and install outdoor concrete equipment pads and transformer vault.
 - c. Creating and sealing interior penetrations.
 - d. Patching and painting of interior openings created by demolition.
 - e. Demolition of trees.
 - f. Exterior and interior trenching.
 - g. Removal and reinstallation of ceiling tiles for routing of branch circuit wiring.
2. The General Contractor will:
 - a. Provide flashing and creating roof penetrations
 - b. Removal and reinstallation of ceiling tiles for routing of panelboard feeder conduits.
 - c. Creating and sealing exterior envelope penetrations.
 - d. Resurfacing of trenching areas in grass, concrete pavement, asphalt and Astroturf (stone base only). Refer to trenching details for more information.
 - e. Demolition of top layers of trenched areas in concrete pavement, asphalt and Astroturf (stone base only). Refer to trenching details for more information.

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 two-year warranty on parts and labor. This warranty shall supersede all notations in all the other Division 26 specification sections.

PART 2 - PRODUCTS (Not applicable).

PART 3 - EXECUTION (Not applicable).

END OF SECTION

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 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. Increase, by the quantity listed below, the number of electrical related shop drawings, product data, and samples submitted, to allow for required distribution plus two copies of each submittal required, which will be retained by the Engineer.
 - 1. Shop Drawings - Initial Submittal: 1 additional blue- or black-line prints.
 - 2. Shop Drawings - Final Submittal: 1 additional blue- or black-line prints.
 - 3. Product Data: 1 additional copy of each item.
 - 4. Samples: 1 addition as set.
- C. 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 26 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. Where surfaces are newly exposed due to electrical demolition work, the EC shall repair the surface to match the existing and/or based on the Architect's direction.
 - 4. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
 - 5. 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.
 - 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 - 7. 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.
 - 8. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
 - 9. 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.

#26-016.01

260400 - 3

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.
 - 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

PART 1 - GENERAL

1.1 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."

#26-016.01

260500 - 2

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.
 - 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 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.

#26-016.01

260500 - 3

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.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

#26-016.01

260500 - 4

- 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: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

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:
 - 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.
- B. Allowable conduit and MC cable locations:
 - 1. Conduit shall be used for all wiring to all equipment in corridors, storage rooms, multipurpose rooms, stages, electrical rooms, boiler rooms, cafeteria, gymnasiums, utility chases and the like. Conduit shall also be used for all non-public, exposed conditions.
 - 2. MC Cable may be used within an individual room or a maximum of 10' in corridors. MC cable may not feed from room to room or between rooms.

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.

#26-016.01

260519 - 2

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. 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 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.

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.

#26-016.01

260519 - 3

2.3 SLEEVES FOR 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 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. Stranded for sizes.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- B. Underground Feeders: Type THHN-THWN, single conductors in Type PVC schedule 40 UL listed conduit. Refer to drawings for ductbanks requiring encasement in 3" of concrete.
- C. Feeders Concealed in Ceilings, Walls, Partitions: Type THHN-THWN, single conductors in raceway.

#26-016.01

260519 - 4

- D. Use the following wiring methods as indicated for all branch circuits:
1. Outdoor, underground: Type 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. Elevator machine rooms.
 - e. Cell blocks, including cells: Embedded in concrete. In no case shall exposed conduit be installed within a cell.
 - f. Above hard / drywall ceilings.
 - g. Room with exposed ceiling structure.
 - h. In concrete block walls.
 3. Indoor, concealed in drywall walls and accessible ceilings and not in areas listed above in D.2.: Type MC aluminum-clad multi-conductor copper cabling with ground.
- E. Dimming Lighting Branch Circuits: Where branch circuit wiring is routed to 0-10V dimming light fixtures and switches, UL listed metalclad type MC-PCS (Power & Control/Signal) cable.
- F. Class 1 Control Circuits: Type MC Cable.
- G. Class 2 Control Circuits: Type MC Cable.
- H. Fire Alarm: Type MC FPLP cabling where concealed in walls, accessible ceilings and partitions and Type THHN-THWN, in raceway where exposed or as outlined in D.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.

#26-016.01

260519 - 5

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 according to Division 07 Section "Joint Sealants."
- 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."
- L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

#26-016.01

260519 - 6

- 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: Install cast-iron "wall pipes" for sleeves. 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.

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 methods and materials for grounding systems and equipment, plus the following special applications:
 - 1. Building 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.

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.

#26-016.01

260526 – 2

- 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: 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 837-2002, 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).
 - 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.

#26-016.01

260526 – 3

- 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 and Poles: Compression connectors.
 - 5. Connections to Structural Rebar: Compression 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.

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.
- 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 a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- B. Perform the following tests and inspections and prepare test reports:

#26-016.01

260526 – 4

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

PART 1 - GENERAL

1.1 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:

#26-016.01

260529 – 2

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.

#26-016.01

260529 – 3

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.
- G. Roof conduit supports:
 - 1. Support of gas and refrigeration piping systems, cable tray, electrical conduits, multiple lines, HVAC equipment and other applications.
 - 2. Base with 14 ga. Galv. Channel (13/16" high).
 - 3. Installation on any roofing materials or other flat surfaces.
 - 4. Minimum height 4"
 - 5. Maximum Load: 500 lbs./ft.
 - 6. UV / Weather Resistant.
 - 7. No roof penetration required; shall not float or blow away.
 - 8. Shall be made from 100% recycled rubber.
 - 9. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB C-Port
 - b. Cooper B-Line Dura Blok

c. C-Port C Series

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:
 - 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.

#26-016.01

260529 – 5

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.

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

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, floor boxes, surface divided non-metallic raceway, power poles, 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.

#26-016.01

260533 – 2

- 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. Alflex 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:

#26-016.01

260533 – 3

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:

#26-016.01

260533 – 4

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 SURFACE METALLIC RACEWAY

- A. Provide and install V500 or V700 series surface metal raceway for feeding equipment and devices in exposed, public areas, where fishing MC cable is not possible.
 1. The intent of this project is to use concealed MC cable where possible in existing walls. Where not possible, the use of surface metal raceway shall be required.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 1. Exposed Conduit: Rigid steel conduit.
 2. Concealed Conduit, Aboveground: Rigid steel conduit.
 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried 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. 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.

#26-016.01

260533 – 5

- 5. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4X, stainless steel in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 - 2. 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 fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- I. 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.

#26-016.01

260533 – 6

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.
- 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.

#26-016.01

260533 – 7

- N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway and sleeve for installing mechanical sleeve seals.

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

PART 1 - GENERAL

1.1 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.

#26-016.01

260553 – 2

- 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.
 - 3. Embedded continuous metallic strip or core (detectable).

#26-016.01

260553 – 3

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 EQUIPMENT 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: 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.

#26-016.01

260553 – 4

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 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 (more than one conductor 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.

#26-016.01

260553 – 5

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.
- 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.
- 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. Voice and data cable terminal equipment.
- s. Master clock and program equipment.
- t. Intercommunication and call system master and staff stations.
- u. Television/audio components, racks, and controls.
- v. Fire-alarm control panel and annunciators.
- w. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
- x. Monitoring and control equipment.
- y. Uninterruptible power supply equipment.
- z. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
- aa. Photovoltaic system equipment, junction boxes, conduits, etc.

#26-016.01

260553 – 6

- bb. Receptacles and 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.
- 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.

#26-016.01

260553 – 7

- 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

PART 1 - GENERAL

1.1 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 lighting control devices:

- 1. Digital Room Controllers
- 2. UL924 Load Controller
- 3. Sensors
- 4. Wall Stations

DEFINITIONS

- B. LED: Light-emitting diode.
- C. PIR: Passive infrared.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Interconnection diagrams showing field-installed wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

#26-016.01

260923 - 2

1.5 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer:
 - 1. Current
 - a. System: NX Lighting Controls System manufactured by HLI Solutions, a division of Current, Greenville SC.
 - 2. Basis of design product: Current NX Series or subject to compliance and prior approval with specified requirements of this section, one of the following:
 - a. Cooper Lighting Controls
 - b. Acuity Brands Lighting Controls
 - c. Wattstopper Digital Lighting Management (DLM)

2.2 DIGITAL ROOM CONTROLLERS

- A. NX Room Controllers
 - 1. Basis of Design Product: Hubbell Control Solutions, NX Room Controllers.
 - 2. As indicated and where shown on the plans, install Hubbell Control Solutions NXRC series Room Controller(s) to control the quantity of lighting and plug loads required.
 - 3. NX Room Controller(s) 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.
 - 4. NX Room Controller(s) 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.
 - 5. NX Room Controller(s) shall have an embedded Time Clock and be capable of storing and running up to 99 local schedules. Schedules shall run autonomously without the need of any coordinator, gateway, or master controller.
 - 6. Construction:
 - a. NX Room Controller housing shall be constructed of GSM UL rated 94 HB plastic approved for use in a return air plenum.
 - b. The housing shall include an integral 1/2" chase nipple for external mounting to standard junction box knockout.
 - c. Two RJ45 FX Port connectors shall be accessible on the side of the enclosure for expansion of a Zone Segment to allow for an expanded number of Zone Segment devices (e.g., Room Controllers, In-Fixture Modules, and Digital Sensors). Up to 32 controllers and devices can be daisy-chained together.
 - d. Two RJ45 SmartPORT™ connectors shall be accessible on the side of the enclosure for the connection of NX room level devices.

- e. Two recessed push buttons and associated LED indicators shall be accessible on the top of the enclosure to provide override, status, setup, and testing functions.
- 7. Electrical:
 - a. NX Room Controller(s) shall have a single power feed and shall be capable of operation at voltages between 120/277/347 volts AC, 50/60 Hz.
 - b. One or two output relays (model specific) shall provide for the following load types and ampacity (per relay):
 - 1) 20A, Tungsten,
 - 2) 20A, Magnetic Ballast,
 - 3) 16A, Electronic Ballast,
 - 4) 1 H.P. Motor @ 120V, ¾ H.P. @ 277V; ½ H.P. @ 347V
 - c. 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.
 - d. Each dimming output shall have a current sinking capacity of at least 30 mA.
 - e. NX Room Controller(s) shall be capable of supplying 250 mA of Class 2 auxiliary DC power for use by wall switch stations, occupancy sensors, and daylight sensors connected to the room controller's two RJ45 SmartPORT connectors.
 - f. NX Room Controller(s) shall be equipped with power monitoring circuitry capable of measuring and reporting the total connected load for each roomcontroller.
- 8. Functional:
 - a. 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.
 - b. NX Room Controller(s) shall have a default operation providing an automatic logical sequence of operation for each load as the room control devices are plugged into the SmartPORT connectors.
 - c. Default operation for occupancy sensors shall be automatic on, automatic off for all loads.
 - d. Upon connection of a switch, the operation shall automatically change to manual on, automatic off (vacancy) mode for all loads.
 - e. 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.
 - f. When in vacancy mode, provide a 30 second grace period after an off during which automatic on shall be temporarily enabled.
 - g. It shall be possible to connect up to thirty-two (32) room controllers together on the FX Ports using Cat5 patch cables to provide configurations up to 64 switched and dimmed loads operating as a single zone.
 - h. Provide the following set up and configuration functions without the need for additional devices or software:
 - 1) Assign/reassign relays for control by wall switch station buttons,
 - 2) Configure relays for occupancy or vacancy operation,
 - 3) Assign/reassign dimmers to raise/lower switches,
 - 4) Assign dimming channels for response to daylight sensor control,
 - 5) Auto calibrate default daylight sensor sequence of operation,
 - 6) Save preset scenes.
- 9. NX Room Controller(s) shall support the following specialty modes:
 - a. SpectraSync™ CCT Control
 - 1) Dimmer channels can be set individually to control CCT via 0-10V.
 - 2) Scheduling can be implemented to mimic the natural transition of light throughout the course of the day.

#26-016.01

260923 - 4

- 3) Room-based solutions can be implemented to allow occupants to tune color to task.
- b. SpectraClean™
 - 1) Ability to control SpectraClean enabled fixtures with three different modes for varying applications:
 - a) Constant On
 - b) Scheduled
 - c) Programmed Dosage

2.3 UL924 LOAD CONTROLLER

A. NX UL924 Load Controller

1. Basis of Design Product: Hubbell Control Solutions, NX UL924 Load Controller.
2. As indicated and where shown on the plans, install Hubbell Control Solutions NX UL924 Load Controller to control the quantity of emergency lighting loads required.
3. NX UL924 Load Controller shall meet NFPA Article 700 requirements for emergency lighting.
4. NX UL924 Load Controller 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.
5. NX UL924 Load Controller shall provide a remote test button or fire alarm interface.
6. NX UL924 Load Controller shall have an embedded Time Clock and be capable of storing and running up to 99 local schedules. Schedules shall run autonomously without the need of any coordinator, gateway, or master controller.
7. Construction:
 - a. NX UL924 Load Controller housing shall be constructed of GSM UL rated 94 HB plastic approved for use in a return air plenum.
 - b. The housing shall include an integral 1/2" chase nipple for external mounting to standard junction box knockout.
 - c. Two RJ45 FX Port connectors shall be accessible on the side of the enclosure for expansion of a Zone Segment to allow for an expanded number of Zone Segment devices (e.g., Room Controllers, In-Fixture Modules, and Digital Sensors). Up to 32 controllers and devices can be daisy-chained together.
 - d. Two recessed push buttons and associated LED indicators shall be accessible on the top of the enclosure to provide override, status, setup, and testing functions.
8. Electrical:
 - a. NX UL924 Load Controller shall have a single power feed and shall be capable of operation at voltages between 120/277/347 volts AC, 50/60 Hz.
 - b. One relay output shall provide the following load types and ampacity:
 - 1) 20A, Tungsten,
 - 2) 20A, Magnetic Ballast,
 - 3) 16A, Electronic Ballast,
 - 4) 1 H.P. Motor @ 120V; ¾ H.P. @ 277V; ½ H.P. @ 347V.
 - c. NX UL924 Load Controller shall provide two independent 0-10 volt dimming channels for full range dimming control of fixtures equipped with compatible dimmable ballast or driver.
 - d. Each dimming output shall have a current sinking capacity of at least 30mA.
 - e. NX UL924 Load Controller shall be equipped with power monitoring circuitry capable of measuring and reporting the total connected load for each room controller.

9. Functional:
 - a. SmartPORT Functionality:
 - 1) NX UL924 Load Controller shall automatically recognize connected devices in the Zone Segment.
 - 2) NX UL924 Load Controller shall function as a standard room controller.
 - 3) NX UL924 Load Controller's RJ45 CAT5 connection shall be used as a sensing line to standard room controller only and does not support NX room devices.
 - b. Emergency Functionality:
 - 1) NX UL924 Load Controller's RJ45 CAT5 connection shall be used as a sensing line to standard room controller on normal circuit.
 - 2) Removal of 24VDC on CAT5 connection shall put NX UL924 Load Controller into emergency state.
 - 3) NX UL924 Load Controller's default emergency state is ON with both dimming channels to 100%
 - c. Provide an integral pushbutton and LED indicator for controlled load for status and to allow operation of the relay and dimmers for testing and verification without requiring other control devices to be connected.
 - d. Provide the following set up and configuration functions without the need for additional devices or software:
 - 1) Assign/reassign relays for control by wall switch station buttons,
 - 2) Configure relays for occupancy or vacancy operation,
 - 3) Assign/reassign dimmers to raise/lower switches,
 - 4) Assign dimming channels for response to daylight sensor control,
 - 5) Save preset scenes.
10. NX UL924 Load Controller shall support the following specialty modes:
 - a. SpectraSync™ CCT Control
 - 1) Dimmer channels can be set individually to control CCT via 0-10V.
 - 2) Scheduling can be implemented to mimic the natural transition of light throughout the course of the day.
 - 3) Room-based solutions can be implemented to allow occupants to tune color to task.
 - b. SpectraClean™
 - 1) Ability to control SpectraClean enabled fixtures with three different modes for varying applications:
 - a) Constant On
 - b) Scheduled
 - c) Programmed Dosage

2.4 SENSORS

A. NX Occupancy Sensors, Wired

1. Basis of Design Product: Hubbell Control Solutions, NX Occupancy Sensors.
2. NX 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.
3. NX Occupancy Sensors shall be Class 2 and connect to any room controller SmartPORT using a wiring adaptor and standard Cat5 patch cable.

#26-016.01

260923 - 6

4. NX Occupancy Sensors shall be microprocessor controlled and utilize IntelliDAPT® technology to optimize sensor behavior to adapt to space conditions and occupant usage patterns and adjust sensitivity and time delay to maximize energy savings and minimize false On and Off events
5. NX Occupancy Sensors shall be self-adaptive and not require manual calibration after installation. Digital circuitry and logic shall automatically adjust the sensitivity and time delay based on learned occupancy patterns and the environment in which the sensor is installed.
6. NX Occupancy 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.
7. Up to four NX Occupancy Sensors may be connected to one room controller.

B. NX Contact Closure Interface

1. Basis of Design Product: Hubbell Control Solutions, NXCI Series Contact Closure Interface.
2. NX Dry Contact Closure Interface shall enable third-party devices to provide dry contact inputs to the NX lighting control system.
3. NX Dry Contact Closure Interface shall provide switch activation using contact closures from external devices such as key switches, AV systems, photo-eye sensors or other low voltage Class 2 devices.
4. NX Dry Contact Closure Interface shall default to On/Off operation and can be programmed to perform alternate functions including:
 - a. Toggle On/Off
 - b. Preset
 - c. Raise
 - d. Lower
 - e. Timed On
5. NX Dry Contact Closure Interface shall feature a removable terminal block for input connection.
6. NX Dry Contact Closure Interface shall feature pilot light output terminals.
7. NX Dry Contact Closure Interface shall be a low voltage device: 24VDC.

2.5 WALL STATIONS

A. NX Smart Switches

1. Basis of Design Product: Hubbell Control Solutions, NX NXSW Series Smart Switches.
2. NX Smart Switches shall be of the programmable type using standard Cat5 cabling for connection to system SmartPORT™.
3. NX Smart Switches shall have one to six buttons and provide lighting control functions as called out and shown on the plans.
4. NX Smart Switches shall be available with the following specialty versions:
 - a. OO: On/Off
 - b. ORLO: On/Raise/Lower/Off
 - c. RL: Raise/Lower
 - d. TO: Timed-On
 - e. SS: Scene
5. Construction:
 - a. Housing: Rugged, high impact, injection molded plastic

- b. Mounting: Switches shall be capable of being mounted to single-gang and multi-gang wall boxes and shall be compatible with standard decorator style wall plates.
- 6. Electrical:
 - a. Class 2 Low Voltage 24VDC
 - b. Connection via two (2) RJ-45 SmartPORTs to allow for daisy chain connection of up to eight switches to each SmartPORT.
- 7. NX Smart Switches shall be available in White, Ivory, Light Almond, Gray, Black, and Red.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 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.

3.4 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 luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.5 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.

3.6 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 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

#26-016.01

262416 – 1

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:
 - 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

#26-016.01

262416 – 2

- 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:

- 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.

#26-016.01

262416 – 3

- 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.
- 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

#26-016.01

262416 – 4

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.

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.
- 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

#26-016.01

262416 – 5

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.
- 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.

#26-016.01

262416 – 6

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

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. Snap Switches
 - 3. Ground Fault Circuit Interrupter Receptacles
 - 4. 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

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.

#26-016.01

262726 - 2

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. Where receptacles are wired to normal/emergency or emergency only circuits, provide red colored receptacles, with ratings equal to above.
- C. Tamper-Resistant Receptacles (TR): Provide tamper-resistant 20A receptacles equal to Hubbell Wiring Devices BR20TR.
- D. 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 GFTWRST20 series, which comply with 2015 UL 943 for self-testing requirements. Verify color selections with Architect.
- E. 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.

2.3 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. Material for Wet Locations: Low profile, expandable, die-cast metal extra duty cover, and listed and labeled for use in "wet locations." Provide aluminum while-in-use cover MX4280S by Hubbell TayMac or approved equal.

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

#26-016.01

262726 - 3

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. 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